Available online at www.sciencedirect.com
SCIENCE DIRECT®
Lingua 116 (2006) 950–975
Lingua
www.elsevier.com/locate/lingua

# The symbiosis between perception and grammar in loanword phonology

Moira Yip *

*University College London, London, UK*

Received 15 November 2004; received in revised form 18 March 2005; accepted 2 May 2005
Available online 7 October 2005

**Abstract**

This paper takes the view that loanword adaptation results from attempts to match the non-native percept of the L2 input, within the confines of the L1 grammar. Neither a purely perceptual nor a purely grammatical account can explain the facts. The L1 grammar includes constraints specific to mimicking foreign inputs. Where not all aspects can be replicated, the grammar prioritizes. In the Cantonese vowel data examined here, tone (the reflex of English stress) and consonants are more carefully replicated than vowel quality, and vowel length is even less important than vowel quality. The paper examines acoustic and psycholinguistic data on L2 vowel perception, and looks closely at the adaptation of English [æ] and [ə] in English loans into Cantonese, which lacks both these vowels.


*Keywords:* Loanwords; Vowel perception; Tone

One can distinguish three views on the role of perception in loan adaptation. In the first view, misperception is the primary cause of adaptation. The idea is that the perceptual scan misses some or many of the L2 donor language distinctions that are missing in the host language. Thus, the input to the phonology may lack some segments entirely. Taken to the extreme, all adaptation takes place in perception (Dupoux et al., 1999; Peperkamp and Dupoux, 2003). A contrasting view is that the percept is fairly close to that of a native speaker of the donor language, with bilinguals having identical percepts and those with little familiarity with the donor language having the most divergent percept. The input to the phonology is more or less the donor language output, at least if bilinguals do the borrowing, and most adaptation is grammatically controlled.

* Tel.: +44 20 7679 3158; fax: +44 20 7383 4108.
*E-mail address:* myip@ling.ucl.ac.uk.

0024-3841/$ – see front matter 
doi:10.1016/j.lingua.2005.05.007

The grammar proper has little or no access to perceptual information (Jacobs and Gussenhoven, 2000; Paradis, 1995; LaCharité and Paradis, 2005).

A third view, and the one espoused in this paper, is intermediate between these two extremes. The percept includes some reflex of most of the non-native segments, but it may differ from the percept of a native speaker of the donor language. The input to the phonology is this transformed percept. The grammar then imposes further changes. This grammar may have access to perceptual information, particularly the relative salience of acoustic and perhaps visual cues, although I will have little to say about this here (Silverman, 1992; Yip, 1993, 2002; Steriade, 2001; Shinohara, 2004; Kenstowicz, 2003).

The model I will be using has the architecture shown below:

L2 source → Perceptual module → non-native percept → L1 grammar → Adapted loanword

It has clear similarities to models proposed in Silverman (1992), Kenstowicz (2001, 2003), and Kenstowicz and Suchato (in press). The evidence for the role of the grammar comes from three sources. First, I look at a case in which different communities with the same L1 host language use different strategies, showing that their grammars are diverging in this one respect. I argue that the L1 grammar must accommodate constraints specific to mimicking foreign inputs (or more precisely their percepts). Second, I show that syllable structure restrictions can cause glide-vowel coalescence, glides to become vowels, or the reverse. Third, I show that grammars set priorities as to which aspects of the percept to preserve, and how to preserve them. For Cantonese matching salient consonants and tone (the reflex of English stress) takes precedence over matching prosodic structure, and this in turn is more important than matching vowel quality, with matching vowel length the least important of all.

The data come largely from English loans into Cantonese, and the paper is organized as follows. I begin in section 1 with a brief preliminary discussion of the role of non-standard languages and interlanguages in loanword adaptation. Section 2 looks at cases where perception alone can explain segment adaptation or deletion. Section 3 turns to cases where the grammar plays the central role. Section 4 is the main part of the paper. It is a case study of the adaptation of English [æ] and [ə] into Cantonese, looking in detail at acoustic and perceptual evidence for the best vowel match, then at the role played by the host language grammar in selecting from the field of plausible candidates. Section 5 sums up.

## 1. Preliminaries

This paper is mainly concerned with loanwords from English into Cantonese. The usual assumption is that the source of the loanwords is either US English or UK English (probably RP). However, there is another possibility. In modern Hong Kong, the majority of English spoken and taught is Hong Kong English (HKE), including by high school teachers of English (Hung, personal communication). HKE, though stable, shares many phonological characteristics with the interlanguages of Cantonese L1 speakers learning English as L2. In such cases, this local variety of the source language and/or the interlanguage should be considered as a source of loans. There are obvious similarities between the interlanguage pronunciation of an L2 word, and how it is adapted as a loanword into L1. In both cases the L1 grammar exerts its influence on the pronunciation of the L2 form, but as the language learner progresses in his or her mastery of the new language, the influence of L1 dwindles. For loanwords, it stays stable. The important difference is this: an interlanguage is an attempt to acquire a new grammar in which a novel input

initiates changes from the L1 grammar thereby eventually allowing the L2 word to be perfectly mimicked. This new grammar will not yet be identical to the L2 grammar, and we call it the interlanguage (IL) grammar. However, in loanword adaptation there is no desire to acquire a new grammar or to change the L1 grammar, so matching the percept of the L2 form within the confines of an unchanged L1 grammar may be simply impossible. As a result, the adapted loanword is likely to be more similar to native L1 forms than the IL form is, whereas the IL form is likely to be closer to the L2 form than the adapted loanword is. For example, consider the English word '*raze*' with an initial [r] and a final [z], two segments lacking in Cantonese. In the interlanguage, Hong Kong English (Hung and Man, 2004), the initial [r] becomes 'an alveolar approximant distinct from [w] and [l]', and the final [z] is devoiced to [s]. The devoicing of [z] is clearly the result of L1 influence, since Cantonese has no voiced fricatives. It happens to all instances of English [z], including word-initial ones ('*zeal*' → [sil]), so it cannot be attributed to some sort of coda devoicing. However, the resulting word fails to conform to Cantonese phonology in two ways: it has a non-Cantonese segment as its onset, and the coda is a fricative, although Cantonese allows only stops, nasals and glides in coda position. The loanword equivalent, however, substitutes a legitimate segment [l] for the onset, and epenthesizes a vowel after the fricative, thus removing it from coda position.[1]

| (1) | **L2 (English)** | **IL (HKE)** | **Loanword into L1 Cantonese** |
|---|---|---|---|
| | [rejz] | [ɹejs] | [lej si:] |

I conclude then that we should entertain the possibility that a common route for a loan, under certain sociolinguistic circumstances, is via the interlanguage and/or the local variety of the source L2, and not directly from the standard L2.

The relevance of this to the present study will become clear when we look at vowels, and the pronunciation of the English vowel [æ]. In Hong Kong English this vowel appears to have merged with [ɛ], and this has implications for what we expect when we look at loanwords containing this sound, which is absent in Cantonese. Apart from this, there will also be other places where interlanguage data is included, on the basis that changes from the L2 form are the result of L1 influence, just as they are in loans.

## 2. The role of perception: two examples

### *2.1. Aspects of perception*

We need to distinguish between the perception of the **presence** of a segment or property, the perception of a **distinction** between that segment and another, and the perception of the **basis** of that distinction. For example, consider English voiced fricatives in HKE (Hung and Man, 2004 and personal communication). They are not deleted, but surface as voiceless, so their **presence** is clearly perceived. However, [s,z] both become [s], as in '*zinc*' → [sɪŋ], so the **distinction** between them is not obviously perceived. Nonetheless, the interdental pair [θ, ð] surface as [f] and unaspirated [t], respectively, as in '*thin*' [fɪn] and '*this*'[tɪs], suggesting that for this pair the

[1] I use the word 'raze' because its HKE form is explicitly transcribed by Hung and Man to illustrate their generalizations. This particular word has not been borrowed into Cantonese, but we can be quite sure what would happen, because all loans beginning in [r] or ending in [z] behave in this way, such as *rum, round, rayon, cheese, fuse, pose, size*.

**distinction** is perceived. But is it perceived as a voicing distinction, or as something else? Since the [t] is not truly voiced, apparently not; and indeed for stops, the English 'voicing' difference (which Cantonese lacks) is realized as an aspiration difference, reinterpreting the **basis** of the distinction. So 'pie' is adapted as [pʰaj] and 'bun' as [pɐn]. Finally, note that the perception of any of the presence/distinction/basis triad can be context sensitive (Steriade, 2001; Shinohara, 2001, 2004; Mielke, 2002).

If perception of the L2 form falls short in any of these ways, the loanword adaptation can be attributed entirely to this perceptual shortfall, and not to the phonology at all. I give two examples here.

### 2.2. *Cantonese treatment of English liquids in loans*

Cantonese is CVC, and it has /l/, but no /r/. Word-initially before vowels, English /r/ is adapted as [l], as in '*rum*' → [lɐm]. More interesting is the variable retention and deletion of liquids in Cl and Cr clusters. Loanwords elicited by Leci and Poon (2004) show the following characteristics:

(1) /l/ is retained in Cl clusters: *pleat* [pelit]
/l/ is lost in sCl clusters: *spleen* [sipin]
/r/ is lost in all clusters: *prom* [pɒŋ], *creep* [kip], *spring* [sipɛŋ]

Actual loanwords that illustrate these patterns are given below:

(2)

| | | | | | | |
|---|---|---|---|---|---|---|
| | *rum* | lɐm | *friend* | fɛn | *strawberry* | si: tɔ: pɛ: lej |
| | *lift* | li:p | *plum* | pow lɐm | *sCl* | no examples |

These data extend the set of forms discussed in Silverman (1992) and Yip (1993, 2002), and differ in some respects. In particular, there is no bi-syllabic minimal word requirement, since in these new data /r/ is lost even if the output is mono-syllabic.[2] There is an apparent but illusory minimum word effect with /l/, because any /sCl/ cluster will epenthesize [i] after the /s/, creating at least a bisyllable even if /l/ is lost.

Consider the perceptual implications. Word-initially, /r,l/ are both perceived, but apparently not distinguished, since both become [l]. In a stop-liquid cluster, /l/ is clearly perceived. What about /r/? If /r/ were perceived, it would not be distinguishable from /l/, since the cues are no better than in word-initial position. Therefore, both /l,r/ should be treated the same. They are not, so we must conclude that /r/ is not perceived. Finally, what about after /sC/? If /r/ is not perceived after a plain C, surely it cannot be perceived here either. After /sC/, however, /l/ also deletes, so the simplest assumption is that it also is not perceived here. These effects can be seen as resulting from the intersection of two influences on perceptibility: the phonological environment, and the phoneme inventory. Moving from easiest to hardest, the environments rank as follows: #_V > #C_V > #sC_V.

[2] There is considerable variation in actual loanwords. For example, 'cream' is usually adapted as [kej li:m], but Cheung Pak-man (personal communication) gives the alternant [kʰʷi:m]. English [r] survives as [l] even from many clusters, possibly as the result of orthographic influence. The minimal word effect reported in Silverman and Yip *does* seem to be true for the more established loans, but apparently not for the data collected by Leci and Poon.

The phoneme inventory favours /l/ over /r/, since Cantonese has no /r/. Contrast Fijian (Kenstowicz, 2003:14) which has an r/l contrast, and borrows *scrum* as [sikaramu]. I conclude that there is no clear role for phonology here. All this deletion may take place in perception.[3] Finally, the variability seen in the different data sources comes from the fact that perception of L2 is difficult but not impossible, and can be learnt. Those with more exposure to English are more likely to perceive /r/.

### 2.3. Cantonese treatment of final CC clusters

My next case, also from Cantonese, concerns final consonant clusters. Cantonese only allows one final consonant, and it must be a voiceless stop, nasal, or glide. Single unsyllabifiable final consonants are rescued by vowel epenthesis:

| | | | | |
|---|---|---|---|---|
| (1) | bus | pa:.si: | pence | pʰi:n.si: |
| | file | fa:j low | size | sa:j si |

Final clusters present a puzzle: In a final cluster, if C2 is a stop, then epenthesis of one vowel could create a new legal final closed syllable, and should also suffice, but deletion occurs instead:

| | | | | |
|---|---|---|---|---|
| (2) | Fric-stop | cast | *kʰa:.si:t | kʰa:.si: |
| | | shaft | *sa:.fi:t | sʌp |
| | | soft | *sɔ:fu:t | sɔ:fu: |
| | Nas-stop | sink | *sɪŋ.kʰi: | sɪŋ |
| | | band | *pɛ:n.ti:,*pɛ:.ni:t. | pɛ:n |
| | Glide-stop | mike | *ma:j.kʰi:, *ma: ji:k | ma:j |
| | | loud | *la:w.ti | la:w [NB: HKE example: Hung ) |

Suppose these stops are perceived, but a low priority is placed on their retention, proportional to their perceptibility (Steriade, 2001; Wilson, 2001; Shinohara, 2004). Then we encounter a problem: if they are perceived, no OT grammar can *ever* prefer [kʰa:.si:] to *[kʰa:.si:t], because the former will always incur one more violation of MAX, and they will tie on all other constraints [contra Yip, 2002]. Note that NOCODA cannot be appealed to here, since loans like *Jack* > [tsɪk] show that MAX >> NOCODA. We are thus forced to conclude that the final stops in CC clusters are not perceived.

[3] Two alternatives are raised by the reviewers. First, the adaptations could be phonological, if the phonology includes access to some perceptual information such as saliency. This is true, if the grammar consists of a set of constraints based on the hierarchy of environments given above along the lines of Steriade's (2001) work on place contrasts. There is no clear evidence to help us decide between these two approaches. A second reviewer observes that a purely phonological analysis relying on the Threshold Principle of Paradis and LaCharité (1997:408) would also account for these facts. This principle limits the number of repairs allowed in an adaptation, and English [r] always requires one more repair than English [l], because it must be changed into [l]. There are empirical problems with this idea: it predicts, wrongly, that [l] should be retained after a voiceless stop but lost after a voiced stop, because that stop needs to be changed into a voiceless one. But putting this aside, even if the approach can be made to work, it remains the case that a purely perceptual account will also suffice.

As a codicil, note that there is no difference between /nt/ and /nd/, suggesting that the difference is not perceived (as of course it could not be if the segments' presence is not discerned). In languages where /nt, nd/ are treated differentially, it is often secondary cues such as vowel nasalization that are preserved, and not obstruent voicing, as in these data from Kenstowicz (2003) and Shinohara (2004), where the phonetically nasalized vowel in English /Vnt#/, phonetically [ṽt#] is carried over to Yoruba unchanged, and to Fijian as a pre-nasalized stop.

(3)

| *English* | *phonetics* | *Yoruba* | *Fijian* | *Cantonese* |
|---|---|---|---|---|
| Vnt# | ṽt# | ṽ.ti# | v.$^{n}$di# | Vn# |
| Vnd# | Vnd# | V.ni# | v.ni# or v.$^{n}$di# | Vn# |

Unlike Fijian and Yoruba, Cantonese has no nasalized vowels, pre-nasalized C, or obstruent voicing, so preservation of these cues would be a challenge.

I now turn to cases where perception cannot be the whole story.

## 3. Where grammar steps in: two cases

### *3.1. One host language, two different loanword strategies*

My first case is one where a single language, Mandarin, spoken in two communities (Mainland China and Taiwan) shows retention in one place and deletion in the other. Mandarin has a CVC syllable structure, with final consonants limited to [n, ṽ,w,j]. On the mainland, unsyllabifiable English consonants are generally rescued by epenthesis, but in Taiwan they are usually deleted (Data: Lin, 1998; Yip, 2002).[4]

(4)

| **Mainland : preservation** | **Taiwan: deletion** | **English** | **Cons.** |
|---|---|---|---|
| fu.li.**tə**.man | fu.li.man | Friedman | d |
| a.ti.ta.**s** | aj.ti.ta | Adidas | s |
| pwo.**thə** | pi | Burt (Reynolds) | t |
| təŋ.tsə.**r**. | tan.tswo | Denzel (Washington) | l |
| khə.**r**.pa.th**ɕ**jaw.fu | kə.pa.th**ɕ**i.fu | Gorbachev | r |
| na.**fu**.la.ti.nwo.wa | na.la.thi.nwo.wa | Navratilova | v |
| haj.hwa.**s**. | haj.hwa | (Rita) Hayworth | θ |
| s.phi.**r**.pwo.**kə** | s.phi.pwo | (Steven) Spielberg | l, g |
| thaj.tan.ni.**khə** | thje.ta.ni | Titanic | k |

The minor differences between mainland and Taiwan Mandarin would not predict any difference in ability to perceive the excess C, so the loss must be phonological. A possible explanation is

[4] A reviewer says "... proper nouns ... are much more prone to being borrowed/adapted by monolinguals (who cannot possibly have access to L2 phonology and who must operate on the percept) ..." (ellipses mine:MY). I agree, but this is why the data are interesting: the two communities seem to share both L1 grammars and, presumably, percepts of L2, and yet they treat the data differently.

based on the fact that the Mandarin host grammar never encounters unsyllabifiable consonants, and so it has no evidence for the relative ranking of MAX versus DEP (see also Broselow et al., 1998). Loanword inputs are the first time a decision is needed. Suppose then that the initial decisions are random, because MAX ∼ DEP. Eventually within a given speech community this initiates a new grammar, and a pattern emerges.

Plausible though this interpretation is, it encounters certain problems. First, the cross-linguistic preference for retention (Paradis and LaCharité, 1997) suggests a universal initial state in which MAX >> DEP (although see Golston and Yang, 2001, on deletion in White Hmong loanwords; Burenhult, 2001, on deletion in Jahai). Secondly, some languages such as Maori are plausibly analyzed as having deletion in L1, showing that DEP>>MAX, but retention in loans, which requires MAX>>DEP (Yip, 2002).

An alternative is to propose that the faithfulness constraints active in loanword adaptation are not the same as those in the L1 grammar. Let us call them MIMIC, where MIMIC = FAITH-DONORLOAN. MIMIC is the OT instantiation of active loanword incorporation, and enforces faithfulness to the percept (contra Broselow, in press, who argues against what she calls MATCH constraints). It implies some level of awareness of the 'foreignness' of the input, a reasonable enough assumption. Further, I assume that, unlike in L1 or L2 acquisition, a steady-state grammar cannot change under exposure to a limited number of new inputs. Like any other constraints the MIMIC constraints may be ranked anywhere. Very high, and loans will stay noticeably foreign. Moderately high, and retention will result. Very low, and deletion will be found. In the latter two cases, they will be fully nativized. The ranking is not all attributable to the perception grammar (again contra Broselow). Consider these possible Mandarin responses to a stop-final English word like *Titanic:*

| | | | |
|---|---|---|---|
| (5) | OK-σ low, MIMIC high: | Tita[nik] | [non-native] |
| | OK-σ high, MIMIC high: | Tita[ni:.kʰə] | [retention of C: Mainland] |
| | OK-σ high, MIMIC low: | Tita[ni:] | [deletion of C: Taiwan] |

The introduction of such a constraint implies that the listener/speaker is engaged in a distinct task when tackling loanwords, and thus activates a constraint that is otherwise unused when people are simply using their native lexicon. Crucially, however, it is added on to the otherwise unchanged L1 grammar, which dictates such things as syllable structure and inventory of sounds. This does not seem unreasonable, and I shall use MIMIC constraints for the remainder of this paper.

### *3.2. Pre-nuclear glides into Cantonese: the role of syllable structure*

My second case where grammar plays a role involves pre-nuclear glides into Cantonese. Cantonese has labiovelar [kʷ], but no [pʷ, tʷ] or any [Cʲ]. It also has no CGV syllables. So how does it handle English inputs with [Cj] and [Cw] clusters? The data are given below. The words in (a) and (c) come from Chan and Kwok (1982) and Cheung (1986b), respectively (the sources for all the Cantonese data in this paper unless otherwise stated), and the data in (b) were elicited from six native Cantonese speakers studying at UCL.

(6) **a. English kw realized as $k^w$**

| | | | |
|---|---|---|---|
| *queen* | $k^{wh}$i:n | *quart* | $k^w$ɐt[5] |

**b. English pw, tw realized as Ciw or Cü (plus occasional Ci) in elicited loans:**

| | **Ciw** | **Cü** | **Ci** | |
|---|---|---|---|---|
| *sway* | si:wej | | | |
| *swoon* | si:wu:n | | | |
| *twee* | $t^h$i:wi: | $ts^h$ü:i | $t^h$i: | |
| *twin* | $t^h$i:wɪn | $t^h$ü:n | $ts^h$i:n | |
| *switch* | si:wi:ttsi: | | | [Chan and Kwok:46] |

**c. English Cju realized as Ciw, with reversals of syllabicity**

| | | | |
|---|---|---|---|
| *tutor* | $t^h$i:w.$t^h$a: | *fuse* | fi:w.si: |

Crucially, the glide is nearly always realized, either as a secondary articulation, or as an onset after epenthesis, or as a nucleus. The percept must include the glide, and the realization must be a matter of phonology, conditioned by the exigencies of Cantonese syllable structure.

## 4. A case study: adaptations of English [æ], [ə]

Having argued that both perceptual and grammatical factors come into play, the remainder of the paper looks in detail at one case, vowel adaptations from English to Cantonese.

English has two vowels that Cantonese lacks, [æ] and [ə]. I will investigate how these are borrowed. The discussion is structured as follows. I begin with the acoustics and the percept, and argue that the vowel quality percept is indeterminate between two (or more) Cantonese vowels. I then turn to the grammar, and argue that the grammar prioritizes what is matched. A good quality match is preferred to a good length match, but if two vowels match equally well on quality grounds, the best length match is chosen. However, the grammar can over-ride this quality match preference in two ways: it can require a long vowel in an open syllable, and it can require a short vowel in a stop-final syllable with high tone. The grammar sets priorities. Retaining and matching a salient consonant and matching English stress with high tone are more important than conserving word-shape, but matching word-shape is more important than matching vowel quality, so epenthesis and deletion can never be caused by a vowel quality match.

### *4.1. Acoustics of three vowel systems*

I begin with the acoustics of the vowel systems of Cantonese, English, and Hong Kong English, bearing in mind that this is the prevalent version spoken in modern Hong Kong. Cantonese has the following vowel inventory:

(7) **Cantonese vowels:**

| *Long* | | | *Short* | | |
|---|---|---|---|---|---|
| i: | ü: | u: | ɪ | | ʊ |
| ɛ: | | ɔ: | e | ø | o |
| | œ: a: | | | | ɐ |

[5] The lack of aspiration in 'quart' is surprising, but I cite it as given in Chan and Kwok (1982:114). No examples with sCw were found or elicited.

For the first two formants, see Appendix A. In open syllables, all vowels are long. In closed syllables, both long and short vowels are found, but subject to various phonotactic restrictions. In particular, in stop-final syllables with high tones, only short vowels are allowed. Low [œ] and mid [ø] are phonetically central, not front (Lee, 1985; Zee, personal communication), as shown by their relatively low F2.

The standard English vowels are shown below, after Hammond (1999). The tense non-low vowels [i,e,u,o] are typically part of diphthongs. [ʌ] is very similar to [ɐ]. Unstressed schwa, though not phonemic, could be added to the chart. For formant values of [æ] and [ə] see Appendix B.

(8) **Standard American English vowels**

| | | |
|---|---|---|
| i | | u |
| ɪ | | ʊ |
| e | | o |
| ɛ | ʌ | ɔ |
| æ | | a |

The Hong Kong English phonemic vowels are shown below, adapted from Hung and Man (2004).

(9) **HKE vowels**

| | | |
|---|---|---|
| i | | ʊ |
| ɛ | ə˞ | ɔ |
| | ɐ | a: |

The standard English phonemic contrast between long and short, +/−ATR non-low vowels is neutralized, so that *heed/hid* and *hoot/hood* are homophones, presumably because this contrast is missing in Cantonese, where the length and ATR differences are allophonic, conditioned by syllable structure and surrounding consonants. Importantly, [æ] is also missing in HKE, where it has more or less merged with [ɛ], leaving *bet/bat* as homophones. We will discuss this further below.

Note that the standard English vowels [æ], [ə] have no Cantonese counterparts, and HKE also has no [æ], so we can ask how these vowels are treated in loans.

#### *4.1.1. Possible matches for English [æ]*

The most obvious matches for English [æ] are [a] and [ɛ]. One observation makes [ɛ] the leading contender. In some dialects of US English, and crucially in HKE, [æ] and [ɛ] merge, as we have seen, and Cantonese speakers cannot reliably distinguish unmerged English [æ] from [ɛ] in perception or production (Wang, 2002). The chart below shows the first two formants of these two vowels, averaged across seven female speakers of HKE, and it can be seen that HK English [æ] is a subset of HK English [ɛ] (Chart 1).

On the other hand, in noisy conditions, native speakers of English confound [æ] with [a] much more than with [ɛ] (Benki, 2003) and in languages with a five-vowel system, [æ] is usually

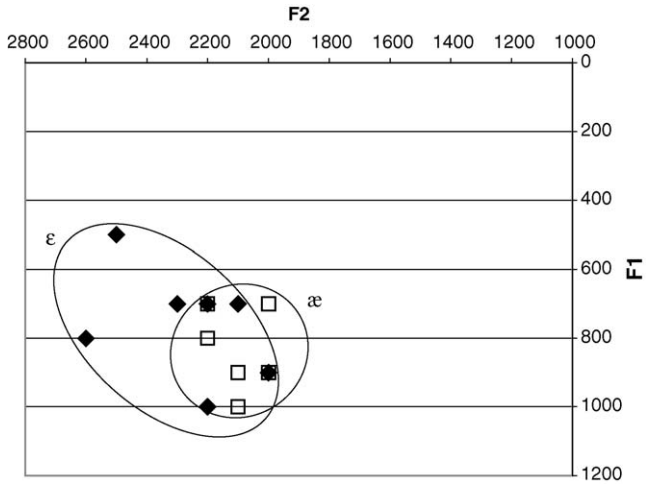


Chart 1. Hong Kong ɛ and æ.

mapped to [**a**], not [e] (e.g. Fijian, Spanish, Kisukuma), although orthography probably plays a considerable role here.[6]

The first two formants of the Cantonese vowels, plus HKE [æ] and [ɛ] shown separately, and RP UK English [æ] are plotted in Chart 2. The HK English vowels are in small squares, and the UK English vowel is in a small circle. The Cantonese and HKE vowels are average values across seven female speakers, and the UK vowel is a single female speaker.

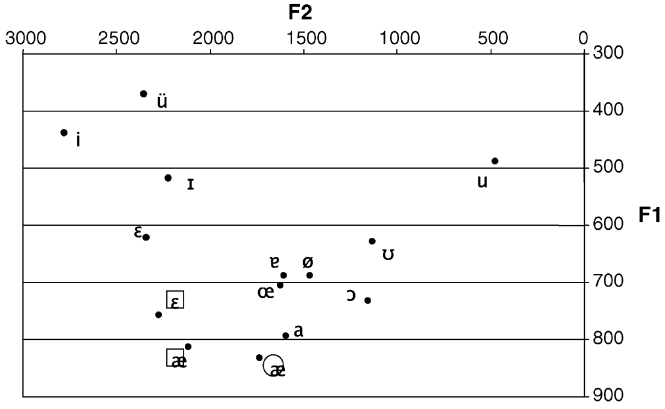


Chart 2. Cantonese vowels plus UK æ and HK æ and ɛ.

[6] In Kisukuma (Matondo, 2003), the adaptation of English unstressed schwa is 100% spelling determined, as shown by these data:

| | | | | | |
|---|---|---|---|---|---|
| Rumania | l[u]mánia | [u] | Toronto: | t[o]lónto | [o] |
| California | kal[i]fónia | [i] | Minnesota | min[e]sóta | [e] |
| kangaroo | kang[a]rúu | [a] | | | |

The male data in Appendix B suggest that UK English [æ] is roughly equidistant from Cantonese [ɛ] and [a]. However, my female data show it much closer to Cantonese [a] than to [ɛ]. On the other hand, HK English [æ] is closer to Cantonese [ɛ] than to [a]. Finally, Cantonese [œ] is also quite close to English [æ]. [ɛ], [a] and [œ] are all long vowels in Cantonese. Since English [æ] is fairly short, we should also ask which of the Cantonese short vowels come closest, and here the answer seems to be [ɪ] and perhaps [ɐ]. To sum up, on acoustic grounds the best matches are these:

(10) **Best matches for English [æ]**
**Closest:** **[ɛ:]** or **[a:]** then **[œ:]**
**Closest short:** **[ɪ],** followed by**[ɐ].**

*4.1.2. Possible matches for English schwa-like vowels*

The extreme acoustic variability of English schwa, particularly of F2, makes it hard to assess its nearest neighbors. Bates (1995) gives UK schwa for male speakers with an F1 of about 450 Hz, and F2 varying from 900 to 1500 Hz depending on context. We have no data on HKE schwa. Nonetheless, comparison between Bates' numbers and Zee's formant values for the Cantonese system suggests that the best match is rounded [œ], which Zee (see Appendix B) gives with an F1 of 531 and an F2 of 1447.

(11) **Best matches for English [ə]:**
**Closest :** **[œ:]. [a:]** a poor second.
**Closest short:** **[ø]** and **[ɐ]** are the best of a bad lot.

*4.2. Cross-language matching task*

The acoustic data are suggestive, but perceptual data are also needed. Given the English vowels [æ] and [ə] and asked to map them onto a Cantonese vowel category, how do listeners respond? A small pilot experiment was carried out in which Cantonese speaking subjects were asked to pick the closest Cantonese rhyme to an English syllable containing the vowel [æ] or [ə], as in the first syllables of '*ga*ther', '*ga*zette'. Two other vowels found in both languages, [a] and [ɛ] were included as controls. The subjects made a forced choice from the Cantonese words [ka:] 'classifier for cars', [kɛ:] 'possessive marker', and [kœ:] 'to saw'. The Cantonese targets were given only in characters to minimize the influence of orthography. There were 5 tokens of each English vowel, across 9 subjects, totaling 45 tokens of each. Subjects ranged in age from 22 to 56 years, and had from 19 to 46 years of exposure to English, but none had spent more than 1 year in an English-speaking country. The results are given below:

(12) **Results of forced choice task to match English vowels with Cantonese [a, ɛ, or œ]**

| Cantonese / English | **a** | **ɛ** | œ | Total |
|---|---|---|---|---|
| a | 97.8% | 2.2% | - | 100% |
| ɛ | 4.4% | 88.9% | 6.7% | 100% |
| æ | 28.9% | **71.1%** | - | 100% |
| **ə** | **51.1%** | 20.0% | 28.9% | 100% |

There was considerable variability, but for [æ] the clear preference was for [ɛ], with [a] in less than one third of cases. For [ə] the picture was much less clear, as one might expect, but [a] was the favorite choice. I now turn to how the actual loanword data compare to what we expect from the acoustic and experimental data.

### *4.3. Cantonese loanword data*

#### *4.3.1. English [æ]*

English [æ] is adapted as follows:

(13) [a:] or [ɛ:] in open output syllables, or before nearly all nasals.
[ɪ] before [k], one [m]
[ɐ] before [t]

Some representative data are shown below:

(14)

| | | | | | |
|---|---|---|---|---|---|
| [a:] | carat | kʰa: | [ɪ] | lacquer | lɪk kʰa: |
| | pan | pʰa:ŋ | | Jack | tsɪk |
| | salad | sa: løt | | taxi | tɪk si: |
| [ɛ:] | cash | kʰɛ: sü | [ɐ] | maxi (clothes) | mɐt s ɐt |
| | cashmere | kʰɛ: si mɛ | | | |
| | daddy | tɛ: ti: | | | |
| | jam | tsɛ:m (or [tsɪm]; Kwok) | | | |
| | cancer | kʰɛ:n sa: | | | |

If we look at the relative frequencies of each vowel we find a strong preference for [a:] when a long vowel is chosen. The data come from a count of all forms with English [æ] in Chan and Kwok (1982) (356 loanwords) and Cheung (1986b) (171 loanwords), excluding those clearly borrowed via Mandarin.

(15) Long vowels: 79% [a:]

| | Open syllables | before nasals | before-k | before -p,t | Total | % |
|---|---|---|---|---|---|---|
| **a:** | 15 | 9 | 2 | 1 | 27 | **79** |
| **ɛ:** | 3 | 3 | - | 1 | 7 | **20** |
| Total | 18 | 12 | 2 | 2 | 34 | |

Given the forced-choice experimental data and the Hong Kong English facts we might have expected a clear preference for [ɛ:] over [a:], but Cantonese phonotactics intervene. Open syllables in [ɛ:] are rare in the Cantonese lexicon, except after coronal sibilants, raising the possibility of a statistical bias. Also, in the native vocabulary [ɛ:] is not found before [m] or [n], but only before [ŋ], drastically limiting its ability to occur before nasals. The three instances of [ɛ] before nasals in the data all create non-native syllables. [a:] on the other hand is virtually unrestricted in its distribution.

Turning to the short vowels, we find a strong preference for [ɪ], although the number of tokens is very small, and this may not be significant.

(16) Short vowels: 67% [ɪ]

| | Open syllables | before nasals | before-k | before -p,t | Total | % |
|---|---|---|---|---|---|---|
| ɪ | - | 1 | 5 | 1 | 7 | **67** |
| ɐ | - | - | 1 | 1 | 2 | **22** |
| Total | - | 1 | 6 | 2 | 9 | |

Like [ɛ:], [ɪ] cannot occur before [m] or [n], and the one example in the data creates a non-native syllable.

Finally, note that before nasals, where either short or long vowels are permitted, the preference for the long vowels is overwhelming (92%). Even before stops, where a short vowel is expected for tonal reasons (see below), we find only 67% short vowels, with the 33% observed long vowel forms being non-native syllables.

*4.3.2. English schwa*

English schwa is adapted as follows:

(17) [a:] in open syllables
[ɐ] or [ø] in closed syllables
[œ:] for stressed schwa-like [ɜ] or [ɝ] plus one [ɛ:]

Representative data are shown below:

(18)

| | | | | | | |
|---|---|---|---|---|---|---|
| [a:]. | 'cancer' | kʰɛ:n sa: | [ɐ] | 'foreman' | fɔ: mɐn |
| | 'major' | mɛ: tsa: | | 'fashion' | fa: sɐn |
| | 'assignment' | a: sai mɐn | | 'commission' | kʰɐm mi: søn |
| [ø] | 'cushion' | kʰu: søn | [œ:] | 'sir' | sœ: |
| | 'gallon' | ka: løn | | 'percent' | pʰœ: sɛ:n |
| | 'salad' | sa: løt | [ɛ:] | 'jersey' | tsɛ: si: |

If we look at the relative frequencies below, the only clear determining factor is open versus closed syllables. I have excluded from the count words where the vowel is none of the main three choices, and is either unexplained, spelling determined, clearly borrowed via Mandarin or attributable to other factors such as vocalization of a following [l]. Such cases amounted to about 15% of the total. Once these are excluded, we find only [a:] in open syllables, and a 60:40 split between [ɐ] and [ø] in closed syllables.

(19) Reflexes of unstressed English schwa:

| | Open syllables | Closed syllables | Total |
|---|---|---|---|
| a: | 58 (100%) | - | 58 |
| ɐ | - | 17 (61%) | 17 |
| Ø | - | 11 (39%) | 11 |
| Total | 58 | 28 | 86 |

[ø] is found only between two coronals. This largely mirrors its distribution in native Cantonese, where it never occurs with labial consonants. It can occur with velars, however, but no such cases have been found in loans. Of the 11 examples where English [ə] is replaced by Cantonese [ø], 4 are the syllable [søn] and 4 are the syllable [løn], plus 1 each of [løt], [tøn] and [tʰøn]. However, we also find many examples of [sɐn], so there seem to be two equally acceptable options.

### *4.4. Summary of three main environments: expected versus actual*

In the following tables, I summarize the results of the preceding sections, comparing the matches we might expect from the acoustic and experimental data with the actual loanword reflexes. Not surprisingly, aside from the front rounded vowels (to be discussed shortly) the correspondence is quite good.

(20) **Open syllables: Vowels must be long, to satisfy μμ minimum syllable requirement.**

| English vowel | Acoustically expected first choice(s) | Expected alternate(s) | Actual in loans |
|---|---|---|---|
| æ | ɛ: a: | œ: | ɛ: a: |
| ə | œ: | a: | a: |

(21) **Closed stop-final syllables: normally short, see section 4.5**

| English vowel | Acoustically expected first choice(s) | Expected alternate(s) | Actual |
|---|---|---|---|
| æ | ɪ | ɐ | ɪ before [k], one ɐ |
| ə | ɐ ø | | ɐ; ø between two coronals |

(22) **Before nasals: long and short vowels permitted**

| English vowel | Acoustically expected first choice(s) | Expected alternate(s) | Actual |
|---|---|---|---|
| æ | ɛː aː | ɪ | ɛː aː (ɪ) |
| ə | œː | aː ɐ (ø between coronals) | ɐ (ø between coronals) |

Other than the absence of the front rounded vowel [œ] (see below), there is a rather good match between the expected and actual vowels. Pre-nasally, where long and short vowels are allowed, it appears that a quality match is more important than a length match, since for the fairly short English [æ] we find the long [aː] and [ɛː] overwhelmingly preferred. The preference for quality matching over length matching is interesting in the light of Boersma and Escudero (2004), who find exactly the reverse for Dutch learners of Spanish, who perceive Spanish |a| as the Dutch vowel /ɑ/ 60% of the time, /ɛ/ 27% of the time, and as long /aː/ only 4% of the time, even though it is the closest vowel from the spectral point of view. As for the Dutch preference for /ɑ/ over /ɛ/, our loanword data in (15) above show a very similar but even stronger preference for the low back vowel over the mid front vowel in Cantonese, although of course the exact vowel qualities across the four languages involved (Dutch, Spanish, English, Cantonese) are not identical.

Some of the details are the result of Cantonese phonotactics. [ɪ] has a fairly restricted distribution, occurring only before velar consonants (before labials and coronals the language has [iː] instead). It is therefore not a possible choice before [m,n,p,t], and of course also not in open syllables. Even before [ŋ] the long vowel reflexes are preferred, suggesting that [ɪ] is not a good quality match. However, as a reflex of [æ] before [k] it is clearly preferred to the other short option, [ɐ], so I will assume it is the best short match and is used when a short vowel is needed, and the phonotactics permit.[7]

[œː] is not used for either [æ] or [ə]. One possibility is that visual information makes a rounded vowel percept implausible for the visibly unrounded English [æ] and [ə]. I should also note that [œ] in Cantonese is very restricted, being almost absent in open syllables. [œ] does occur as a reflex of English stressed schwa after [s] and [p], but not [dʒ]. Perhaps the lip protrusion or rounding of the English onset may be perceived here. [ø] is only chosen for schwa in a sub-set of cases between two coronals. Cantonese 'fronts' the non-low back vowels between coronals, so that we find [sün] and [søn] instead of *[sun] and *[sɔn]. In loans, Cantonese allows both [sɐn] and [søn], *fashion* [faː sɐn] versus *cushion* [kʰuː søn]. Lip protrusion after English [ʃ] may lead to the perception of a rounded vowel in some cases, but this does not explain the cases after other coronals. In any case, if we look at rounding in other instances of loanword borrowings, the idea that hearers pay close attention to visual cues to rounding, and that [ə] fails to go to its closest

[7] Bauer (1985) gives a number of cases where loanwords create new non-native syllables. Several of these create the rhymes [ɛːn], [ɛːm], [ɪm] for English inputs with [ɛ] or [æ]. In such cases, the pressure to mimic the English vowels presumably over-rides the L1 phonotactics. It is possible that [ɛːn], [ɛːm], [ɪm] are accidental gaps, and thus prone to 'filling'.

acoustic match, [œ:], because it is visibly unrounded, is falsified by French loans into the Chadic language Kera (Pearce, personal communication) in which front rounded vowels become front unrounded, not back rounded. The same is also true in Mauritian Creole (Jacobs and Gussenhoven, 2000).

(23)

| | *French* | *Kera* |
|---|---|---|
| painting | pɛ̃ tyr | pantir |
| suit | kɔstym | kɔstim |
| Luke | lyk | liki |
| the time | lœr | lɛr |
| leaf/page | fœj | fɛj |

This pattern is not exceptionless: some front rounded vowels do become [u] or another rounded vowel.

(24)

| | | |
|---|---|---|
| sugar | sykr | sukur |
| doctor | dɔktœr | dɔktɔr |

I leave the question of the role of visual cues open, and will restrict myself to the choices among the unrounded vowels in the remainder of this paper.

Taken together, the data and discussion in this section suggest that speakers entertain more than one option for these novel vowels. If this is so, then the choice in a particular context must be made by the phonology, with more than one possible output being considered as a satisfactory reflex. Formally, this will mean that for each English vowel, more than one Cantonese vowel satisfies MIMIC-VOWEL, where the constraint assesses vowel quality, not length. Specifically:

**(25)**

| **English Vowel** | **Cantonese vowels that satisfy MIMIC-VOWEL** |
|---|---|
| æ | a: ɛ: |
| ə | a: ɐ |

In addition, [ɪ] is a better quality match for [æ] than any other short vowel, but only the two long vowels shown above are a good enough match to satisfy MIMIC-VOWEL.

Before turning to the details of the phonological analysis, I briefly digress to consider a purely phonological alternative to the perceptual account so far. A different approach to the reflexes of sounds in loans is the notion of ''Closest phonological category'' (LaCharité and Paradis, 2005), as measured by the number of features that differ between the foreign target vowel, and the native vowel categories. For the Cantonese data, this notion would work as follows. In the table below I show the relevant Cantonese and English vowels. Unfortunately, there is some disagreement on the ATR values for some of these vowels. The values below are taken from Archangeli and Pulleyblank (1994) on grounding, where [ə,ɐ] are considered [+low, +ATR], and [a, œ] are considered [+low, −ATR]. [æ] is treated by Chomsky and Halle (1968) as lax, or [−ATR]. The features are given below:

| | | high | low | back | ATR | round |
|---|---|---|---|---|---|---|
| English | æ | | + | | | |
| | ə | | + | + | + | |
| Cantonese | a: | | + | + | | |
| | ɐ | | + | + | + | |
| | ɛ: | | | | | |
| | ɪ | + | | | | |
| | ø | | | | | + |
| | œ | | + | | | + |

Below I tally the number of feature differences when a vowel is adapted into Cantonese:

(26) Number of features that differ between target vowel and possible matches

| Cantonese English | a: | ɐ | ɛ: | ɪ | ø | œ: |
|---|---|---|---|---|---|---|
| æ | 1 | 2 | 1 | 2 | 2 | 1 |
| ə | 1 | 0 | 3 | 4 | 4 | 4 |

For [æ] three long vowels [ɛ a œ] tie with one feature difference. In short vowel contexts, all three short vowels [ɐ ɪ ø] tie with two differences. This is not a very good fit to the facts, even if we exclude the rounded vowels, since [ɐ] is in fact never chosen. For schwa, [ɐ] is the clear winner, with no differences, but since it is short it cannot occur in open syllables, so the next best choice would be [a:], with one feature difference. The rounded vowel [ø], a fairly common choice, is wrongly predicted to be a last choice.

Given the disagreement over the ATR values of some of these vowels, one must ask what would change if [ə,ɐ] were considered to be [−ATR], and presumably [−low], since otherwise [ə] cannot be distinguished from [a]. All of the relevant English vowels become a closer match for [ə], since they are also [−ATR], and [ɐ] remains the best match, but now [a:, ɛ:] tie with one difference each (in low and in back, respectively). This is an undesirable result, since [ɛ] is never chosen as a match for schwa. We encounter one of the practical problems with the feature counting approach: the exact choice of features can have far-reaching consequences, and a particular choice of features can bias the result one way or the other.

This brief discussion suggests that the feature-counting approach is not straightforward for these data, and so I shall not consider it further here. Assuming then that the perceptual model leaves several options open, in the next section we turn to how the phonology decides among these various options.

### 4.5. How the phonology works: grammatical mimicry

I begin from the assumption that all plausible long/short (non-round) matches are considered in all contexts. MIMIC-VOWEL can be satisfied by more than one vowel. MIMIC-LENGTH will always favour the short vowel, since English [æ] and [ə] are short. I begin with the pre-nasal context, where Cantonese allows long and short vowels. Short English [æ] has no short Cantonese match that satisfies MIMIC-VOWEL, and since we find only long vowel reflexes in this context, it is clear that MIMIC-VOWEL dominates MIMIC-LENGTH, as shown below. I use two real examples '*pan*' > [pʰaːŋ], and '(*wide*) *angle*' > [ɛːŋ] in which the English words are adapted with final velar nasals, since all three vowels then produce legitimate Cantonese rhymes. Either of the two long vowels may be chosen, on a word-by-word basis. The short vowel is never picked unless the phonotactics require it.

(27) **Quality dominates:**

| '*pan*' /pʰæn/ | '*angle*' /æŋ/ | MIMIC-VOWEL | MIMIC-LENGTH |
|---|---|---|---|
| pʰɛːŋ | ☞ɛːŋ | | * |
| ☞ pʰaːŋ | aːŋ | | * |
| pʰɪŋ | ɪŋ | *! | |

In the same context, schwa behaves differently. Medial schwa is very short, and it is clearly perceived as such. We know that Cantonese speakers perceive vowel length, because the formant structure of Cantonese [aː] and [ɐ] is extremely similar, and Cantonese speakers must use length to distinguish between them (Wang, 2000). We have seen that acoustically short schwa has two possible quality matches, short [ɐ] and long [aː], so here MIMIC-LENGTH decides the matter. The tableau below focuses on the final vowel in English '*foreman*'.

**(28) Length matters too:**

| '*foreman*' /fɔmən/ | MIMIC-VOWEL | MIMIC-LENGTH |
|---|---|---|
| ☞ fɔmɐn | | |
| fɔmaːn | | *! |

So far, Cantonese grammar (as opposed to the MIMIC constraints brought into play only when loans are involved) has played no role in the analysis except in so far as it limits the set of possible matching vowels. But it plays a more active role as well. Open syllables in Cantonese must have long vowels, since syllables are minimally bi-moraic (Cheung, 1986a). As a result the matches for the short English vowels must be long in such contexts. In other words, the L1 grammar takes over and syllable-structure (specifically a constraint $*\sigma_{\mu}$) over-rides MIMIC-LENGTH, forcing a long match even for schwa. The tableau focuses on the final vowel in non-rhotic dialects of English '*corner*'.

(29) **/ə/ in open syllables: *$\sigma_{\mu}$ over-rides length match**

| '*corner*' /kɔ:nə/ | *$\sigma_{\mu}$ | MIMIC-VOWEL | MIMIC-LENGTH |
|---|---|---|---|
| kɔ:nɐ | *! | | |
| ☞ kɔ:na: | | | * |

For [æ] in open syllables, on the other hand, there are still going to be two acceptable candidates, because there are two good matches with long vowels. Different words pick different options, as illustrated in the tableau below with '*salad*', which chooses [a:], and '*Daddy*', which chooses [ɛ:].

(30) **/æ/ in open syllables: two equally good matches are both long anyway**

| '*salad*' /sælət/ | '*daddy*' /tæti/ | *$\sigma_{\mu}$ | MIMIC-VOWEL | MIMIC-LENGTH |
|---|---|---|---|---|
| sɛ:løt | ☞ tɛ:ti: | | | * |
| ☞ sa:løt | ta:ti: | | | * |
| sɪløt | tɪti: | *! | * | |

Exactly the inverse – a preference for [ɪ] – is found in stop-final syllables with high tone (i.e. English stressed syllables) where a short vowel is required because of a quirky Cantonese phonotactic restriction banning long vowels in high-toned stop-final syllables. Here the short match [ɪ] is found before [k], and [ɐ] before [t], since Cantonese has no [ɪt] rhyme. I now turn to a closer look at such cases.

So far we have looked only at situations where the winning candidate(s) satisfy MIMIC-VOWEL. However, matching vowel quality is not always possible, because other considerations can predominate. Stressed syllables must have high tone (shown by a superscript 5) to mimic English stress, but the phonotactic restriction *V:O$^5$ bans long vowels before obstruents with high tone, so in obstruent-final stressed syllables vowels shorten and their quality changes in order to avoid violating MIMIC-TONE, and *V:O$^5$. This is true not only with the approximate matches to [æ] and [ə], but also if vowel quality could otherwise be adopted more or less unchanged as in the different reflexes of [ej] in these two words: '*waiter*' > [wej$^5$ tʰa:] versus '*cake*' > [kʰɪk$^5$]. Returning to [æ], the tableau below shows how this phonotactic restriction forces the choice of [ɪ] in the word '*Jack*' (or '*cake*') where MIMIC-TONE and *V:O$^5$ combine to over-ride a quality match. Candidate (c) lowers the tone a notch, shown by superscripted [4], as in [tsa:k$^4$], and candidate (b) keeps the tone high, but although both mimic the vowel quality accurately, they both lose to (a), with a perfect tone match but a poor vowel match.

(31) /æ/ in stop-final syllables, MIMIC-TONE and *V:O$^5$ combine to over-ride quality match:

| /tsæk$^5$/ | MIMIC-TONE | *V:O$^5$ | MIMIC-VOWEL | MIMIC-LENGTH |
|---|---|---|---|---|
| ☞a. tsɪk$^5$ | | | * | |
| b. tsɛ:k$^5$ / tsa:k$^5$ | | *! | | * |
| c. tsɛ:k$^4$ / tsa:k$^4$ | *! | | | * |

### 4.6. Partial nativization: alternate strategies

In the previous section on stop-final syllables three logical options were considered: (a) shorten the vowel, and use a high tone; (b) retain the vowel length, and use the high tone, even though this combination is non-native; or (c) retain the vowel length, but with a lower tone. The grammar so far will choose option (a), but in fact both options (a) and (b) are well attested, while option (c) does not seem to be used.

(32)

| *(a) Vowel shortened, high tone* | | *(b) Vowel kept long, high tone (non-native)* | |
|---|---|---|---|
| 'shaft' | sɐp$^{5}$ | 'card' | kʰa:t$^{5}$ |
| '(car)-coat' | kʰʊk$^{5}$ | 'chalk' | tsʰɔ:k$^{5}$ |
| 'partner' | pʰɐt$^{5}$ la | 'cheap' | tsʰi:p$^{5}$ |
| 'cake' | kʰɪk$^{5}$ | 'sexy' | sɛ:k$^{5}$ si: |
| '(milk)-shake' | sɪk$^{5}$ | 'notes' | nɔ:k$^{5}$ si: |

The acceptability of the (b) forms, which are non-native, shows that for loans the phonotactic constraint *V:O$^{5}$ may be demoted, and that the loanword grammar is not entirely identical to the native grammar, since it admits a larger set of outputs. See Itô and Mester (1999) on strata in the phonology of a single language. In contrast, the impossibility of the lowered tone option (c) as in 'card' > [kʰa:t$^{4}$] shows that MIMIC-TONE is always high-ranked both in the native vocabulary and in loans. We shall see in the next section that this is part of a larger trend: other prosodic properties such as syllable count and syllable structure are also resistant to change during loanword adaptation.

### 4.7. The limits of the grammar

We have seen above that matching tone is more important than matching vowel quality. I will now show that matching word 'shape' is more important than matching vowel quality, so that epenthesis and deletion can never be caused by a vowel quality match.

To see this, notice there is another option for the stop-final loans discussed above: keep the vowel long and high toned, and either delete the stop or move it into a new syllable followed by an epenthetic vowel. For example, '*card*' could become *[kʰa:$^{5}$] or *[kʰa:$^{5}$ ti:] instead of the actual [kʰa:t$^{5}$]. This never happens: epenthesis or deletion caused by faithfulness to vowel quality or length is forbidden. It appears to be the case that syllable count and structure are preserved as much as possible. This is not surprising: syllable count implies morpheme count in Cantonese, since virtually all morphemes are monosyllabic. It is thus a major bearer of information, and should not lightly be disturbed. Syllable structure is also salient: it interacts with tone, since stop-final syllables can only bear a subset of tones, all level, and a change from a stop-final input to a vowel-final input would also result in phonetic lengthening. Kao (1971) gives the following figures for the average lengths of the vowel and the entire syllable in open syllables and in stop-final syllables. We can see that conversion of a stop-final syllable to an open syllable (even when both have long vowels) results in a vowel length increase of 82%.

(33) Average durations in milliseconds of Cantonese vowels and syllables (data from Kao, 1971)

| | Vowel only | Whole syllable |
|---|---|---|
| V:Stop# | 169 | 207 |
| V:# | 308 | 339 |
| % increase when stop is lost | 82% | 64% |

I shall group changes to syllable structure together under the rubric of MIMIC-STRUCTURE, which has both MAX and DEP components. Together with MIMIC-TONE, these place a high priority on preservation of the prosodic qualities of the input. In the tableau below I have shown *V:O[5] low-ranked, as it would be in the more liberal stratum that allows the partially nativized [kʰa:t[5]] (34b). Even in this stratum, MIMIC-TONE and MIMIC-STRUCTURE are undominated, so candidates (34c–e) will never win. In the stricter stratum *V:O[5] would be ranked above MIMIC-VOWEL (as it was in (31)), and then candidate (34a) would win.

(34) **Prosodic preservation dominates**

| | | MIMIC-STRUCT | | | | |
|---|---|---|---|---|---|---|
| /kʰa:t/ | MIMIC-TONE | MAX | DEP | MIMIC-VOWEL | MIMIC-LENGTH | *V:O[5] |
| a. kʰɐt[5] | | | | *! | * | |
| ☞ b. kʰa:t[5] | | | | | | * |
| c. kʰa:[5] ti: | | | *! | | | |
| d. kʰa:[5] | | *! | | | | |
| e. kʰa:t[4] | *! | | | | | |

Finally, note that MIMIC-STRUCTURE can be violated in certain circumstances. In particular, matching a salient consonant is more important than conserving word shape, so English /s/ is always rescued by epenthesis: '*bus*' [pa:.si:] *[pa:] *[pa:t]. MIMIC-CONS must therefore dominate MIMIC-STRUCTURE.

One can speculate on why perfect mimicry of tones and of consonants is more important than perfect mimicry of vowels, a finding replicated in Savard (in preparation). It is clear that the relative information-carrying capacity of consonants is greater than that of vowels (Nespor et al., 2003; Surendran and Niyogi, 2004) and it may be that this is why consonants are a higher priority for intact preservation. What about tones? Surendran and Niyogi investigate the functional load of tones in Mandarin, and argue that tone in a tone language is more important than stress in a stress language, and carries about the same load as do vowels. If the priority placed on intact preservation is determined by functional load, we might then expect tones and vowels to have about the same priority, but this seems not to be the case. I leave this topic for future research.

## 5. Conclusions

My major conclusions are these:

- Loanword adaptation cannot be assigned entirely to the perceptual module, or entirely to the grammar, but draws on both.
- The grammar may prioritize preservation of some contrasts over others, and the choices cannot be entirely attributed to the L1 influence on the perceptual grammar.
- The role of local varieties of the source language, and interlanguage, must be considered.

I end by comparing the findings of this paper to a very interesting paper by Broselow (in press). She argues that constraint rankings are predictable on the basis of what is contrastive and thus perceived in the L1. For example, Fijian hearers do not need to notice length distinctions, but stress is crucial, so MIMIC-STRESS >> MIMIC-LENGTH. Huave hearers also pay close attention to stress, and for them MIMIC-STRESS >> MAX-C. Selayarese hearers on the other hand pay little attention to stress, and in loanwords MAX-C >> MIMIC-STRESS.

Unlike Fijian, Cantonese must hear both tone (and thus English stress), and length (and of course vowel quality), and yet the grammar prioritizes one over the other: MIMIC-TONE(STRESS), MIMIC-CONS>>MIMIC-VOWEL>>MIMIC-LENGTH. Is this then a counter-example to Broselow's claims? Not necessarily. It may follow from the contrastive role played by tone in Cantonese, and the fact that length co-varies with ATR and with syllable structure (see Yip, 1996), and is not independently contrastive in most cases. However, Wang (2000) does seem to show that the [ɐ] versus [a:] contrast is largely perceived as a length contrast, leaving us with a somewhat blurred picture.

## Acknowledgements

I am grateful to two excellent anonymous reviewers, and to the audience at the 12th Manchester Phonology Meeting, especially Michael Kenstowicz, Carole Paradis, and Sharon Peperkamp, for comments on this paper which made me re-think some aspects of the analysis. Many thanks to the following people for help of various kinds: Lisa Cheng, Billy Cheung, Cheung Pak-man, Sam Cheung, P-M Cheung, Tony Hung, Paul de Lacy, Mark Leci, Emily Luk, Enoch Man, M. Matondo, Mary Pearce, Meoni Poon, Sophie Tang, Sze-Wing Tang, Paul Iverson, Stuart Rosen, and Eric Zee. Sophie Tang and Mary Pearce helped with the vowel formant charts.

## Appendix A. Cantonese vowel formants

Mean values for 10 male speakers, kindly provided by Eric Zee. Similar data may be found in Lee (1985)

Long vowels in open syllables:

| V: | F1 | F2 |
|---|---|---|
| [i] | 322 | 2357 |
| [ü] | 302 | 2010 |
| [ɛ] | 537 | 2088 |
| [œ] | 531 | 1447 |
| [a] | 827 | 1229 |
| [ɔ] | 544 | 871 |
| [u] | 338 | 720 |

Cantonese long vowels in closed syllables:

| V: | F1 | F2 |
|---|---|---|
| [i] | 322 | 2320 |
| [ü] | 362 | 1810 |
| [ɛ] | 679 | 1886 |
| [œ] | 597 | 1410 |
| [a] | 896 | 1270 |
| [ɔ] | 618 | 923 |
| [u] | 405 | 789 |

Cantonese short vowels (always in closed syllables):

| V | F1 | F2 |
|---|---|---|
| [ɪ] | 520 | 2127 |
| [ø] | 572 | 1181 |
| [ɐ] | 820 | 1287 |
| [ʊ] | 518 | 882 |

## Appendix B. English vowel formants: data from male speakers:

**English [æ]:**

| | | F1 | F2 |
|---|---|---|---|
| American [æ] | (Ladefoged, 2001a) | 690 | 1660 |
| UK [æ] | (Bates, 1995) | 756 | 1503 |

- Data on English [ə]. is problematic because of the large amount of contextual variation especially of F2 showing that front/backness is heavily context-dependent. Little data on word-final [ə].

**English [ə]:** F2 is highly context-dependent

| | F1 | F2 |
|---|---|---|
| US [ə] Stevens (1998) | 500 | variable |
| US [ə] Olive et al. (1993) | 500 | context-dependent |
| UK [ə] Ladefoged (2001b) | 500 | 1400 |
| UK [ə] Bates (1995) | 450 | 900–1500 |

**English [ɜ]/[ɜˑ]/[ɜˑ]**

| | | |
|---|---|---|
| US English [ɜˑ] | 450 | 1490 |
| US [ɜˑ] (Olive) | 500 | 1250 |
| UK English [ɜ] (Ladefoged, 2001b) | 500 | 1450 |
| UK [ɜ] (Bates) | 555 | 1380 |

## References


Archangeli, D., Pulleyblank, D., 1994. Grounded Phonology. MIT Press, Cambridge, MA.

Bates, S.A.R., 1995. Towards a definition of schwa: an acoustic investigation of vowel reduction in English. Ph.D. thesis, University of Edinburgh.

Bauer, R., 1985. The expanding syllabary of Hong Kong Cantonese. Centre Langues de L'Asie Orientale XIV (1), 99–111.

Benki, J., 2003. Analysis of English nonsense syllable recognition in noise. Phonetica 60 (2), 129–157.

Boersma, P., Escudero, P., 2004. Learning to perceive a smaller L2 vowel inventory: an Optimality Theory account. Unpublished manuscript, University of Amsterdam and Utrecht University.

Broselow, E., in press. Language contact phonology: richness of the stimulus, poverty of the base. In: Moulton, K., Wolfe, M. (Eds.), Proceedings of the Thirty-fourth Annual Meeting of the Northeastern Linguistics Society, Amherst, MA. GLSA.

Broselow, E., Chen, S.-I., Wang, C., 1998. The emergence of the unmarked in second language phonology. Studies in Second Language Acquisition 20, 261–280.

Burenhult, N., 2001. Loanword phonology in Jahai. Lund Working Papers 48, 5–14.

Chan, M., Kwok, H., 1982. A Study of Lexical Borrowing from English in Hong Kong Chinese. University of Hong Kong, Hong Kong.

Cheung, K.-H., 1986a. The phonology of present-day Cantonese. Ph.D. dissertation, University College, London.

Cheung, Y.-S., 1986b. Xianggang Guangzhouhua Yingyu yinyi jieci de shengdiao guize [On the tone system of loanwords from English in Hong Kong Cantonese]. Zhongguo Yuwen 1, 42–50.

Chomsky, N., Halle, M., 1968. The Sound Pattern of English. Harper and Row, New York.

Dupoux, E., Kahehi, K., Hirose, Y., Pallier, C., Mehler, J., 1999. Epenthetic vowels in Japanese: a perceptual illusion? Journal of Experimental Psychology: Human Perception and Performance 25, 1568–1578.

Golston, C., Yang, P., 2001. White Hmong loanword phonology. In: Féry, C., Green, A.D., van de Vijver, R. (Eds.), Proceedings of HILP 5. University of Potsdam, pp. 40–57.

Hammond, M., 1999. The Phonology of English: A Prosodic Optimality-Theoretic Approach. Oxford University Press, New York.

Hung, T., Man, V., 2004. The interlanguage phonology of Hong Kong learners of English: pedagogical implications. Unpublished manuscript, Hong Kong Baptist University.

Itô, J., Mester, A., 1999. The phonological lexicon. In: Tsujimura, N. (Ed.), A Handbook of Japanese Linguistics. Blackwell, Oxford, pp. 62–100.

Jacobs, H., Gussenhoven, C., 2000. Loan phonology: perception, salience, the lexicon, and OT. In: Dekkers, J., van der Leeuw, F., van der Weijer, J. (Eds.), Optimality Theory: Phonology, Syntax and Acquisition. Oxford University Press, pp. 193–210.

Kao, D., 1971. The Structure of the Syllable in Cantonese. Mouton.

Kenstowicz, M., 2001. The role of perception in loanword phonology. Linguistique Africaine 20 (also published in Studies in African Linguistics 32, 95–112).

Kenstowicz, M., 2003. Salience and similarity in loanword adaptation: a case study from Fijian. To appear in Language Sciences.

Kenstowicz, M., Suchato, A., in press. Issues in loanword adaptation: a case study from Thai. Lingua.

LaCharité, D., Paradis, C., 2005. Category preservation and proximity versus phonetic approximation in loanword adaptation. Linguistic Inquiry 36, 223–258.

Ladefoged, P., 2001a. A Course in Phonetics, fourth ed. Harcourt, Fort Worth, TX.

Ladefoged, P., 2001b. Vowels and Consonants: Introduction to the Sounds of Languages. Basil Blackwell, Oxford.

Leci, M., Poon, M., 2004. Resolving consonant clusters: An OT analysis of English loanwords into Cantonese. University of Washington Working Papers in Linguistics, 23, 103–118.

Lee, T., 1985. The phonetic quality and long/short distinction of Cantonese vowels. Fangyan 7 (1), 28–38 (in Chinese).

Lin, J., 1998. From transliteration to grammar: a study of adaptation of foreign names into Chinese and Taiwanese Mandarin. Unpublished manuscript, UCIrvine.

Matondo, M., 2003. Tone and prosodic morphology in K'sukuma, Ph.D. thesis, U.C.L.A.

Mielke, J., 2002. Turkish /h/ deletion: evidence for the interplay of speech perception and phonology. Proceedings of NELS 32 (2), 383–402.

Nespor, M., Mehler, J., Peña, M., 2003. On the different role of vowels and consonants in language processing and language acquisition. Lingue e Linguaggio 2, 221–247.

Olive, J.P., Greenwood, A., Coleman, J., 1993. Acoustics of American English Speech: A Dynamic Approach. Springer-Verlag, New York.

Paradis, C., 1995. Derivational constraints in phonology: evidence from loanwords and implications. In: Dianora, A., et al. (Eds.), Proceedings of the Chicago Linguistics Society, vol. 31. Chicago Linguistics Society, Chicago, pp. 360–374.

Paradis, C., LaCharité, D., 1997. Preservation and minimality in loanword adaptation. Journal of Linguistics 33, 379–430.

Peperkamp, S., Dupoux, E., 2003. Reintepreting loanword adaptations: the role of perception. In: Proceedings of the 15th ICPHS, Barcelona, pp. 367–370.

Savard, M., in preparation. Nativisation phonologique d'emprunts anglais nord-americains en italien calabrais. Ph.D. thesis, Laval University.

Shinohara, S., 2001. Emergence of universal grammar in foreign word adaptation. In: Kager, R., Pater, J., Zonneveld, W. (Eds.), Fixing Priorities: Constraints in Phonological Acquisition. Cambridge University Press.

Shinohara, S., 2004. Perceptual effects in consonant deletion patterns in loanword phonology. Unpublished manuscript, CNRS.

Silverman, D., 1992. Multiple scansions in loanword phonology: evidence from Cantonese. Phonology 9, 289–328.

Surendran, D., Niyogi, P., 2004. Measuring the usefulness (Functional Load) of phonological contrasts. Unpublished manuscript, Computer Science Department, University of Chicago.

Steriade, D., 2001. Directional asymmetries in place assimilation: a perceptual account. In: Hume, E., Johnson, K. (Eds.), The Role of Speech Perception Phenomena in Phonology. Academic Press, San Diego, pp. 219–250.

Stevens, K., 1998. Acoustic Phonetics. MIT Press.

Wang, X., 2000. Training Mandarin and Cantonese speakers to identify English vowel contrasts: long-term retention and effect on production. JASA 108 (5), 2653.

Wang, X., 2002. Training Mandarin and Cantonese speakers to identify English vowel contrasts: long-term retention and effects on production. Ph.D. dissertation, Simon Fraser University, Canada.

Wilson, C., 2001. Consonant cluster neutralization and targeted constraints. Phonology 18 (1), 147–196.

Yip, M., 1993. Cantonese loanword phonology and Optimality Theory. Journal of East Asian Linguistics 2, 261–291.

Yip, M., 1996. Lexical optimization in languages without alternations. In: Durand, J., Laks, B. (Eds.), Current Trends in Phonology: Models and Methods. CNRS, Paris-X, University of Salford, University of Salford Publications, pp. 757–788.

Yip, M., 2002. Necessary but not sufficient: perceptual loanword influences in loanword phonology. In: Kubozono, H. (Ed.), The Journal of the Phonetic Society of Japan. Special issue on Aspects of loanword phonology, vol. 6.1, pp. 4–21.