

Emergent Rankings in Foreign Word Adaptations

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1. Introduction

In this paper we address two problems in loanword phonology: (i) why some foreign structures are more likely to be preserved than other equally novel foreign structures and (ii) why particular repairs for foreign structures are favored, even when the native language offers a choice of possible mappings to legal native structures.

We will focus on the adaptation of the structures [ti] and [si] in words borrowed from English into Japanese. Although neither [ti] nor [si] is attested in native Japanese vocabulary, [ti] is far more likely than [si] to be preserved in established loanwords, as illustrated by the pronunciation of ‘Citibank’ as [ʃitibanku] (Itô & Mester 1995, 1999, 2001), where [s] is palatalized but [t] is retained.¹ This asymmetry exemplifies a problem in loanword adaptation that has been called *differential difficulty* (Broselow 2009) or *differential importation* (Kang 2011), in which some novel foreign structures are more readily accepted than others. Such asymmetries can generally be described in terms of relative rankings among markedness (M) constraints, and the Japanese asymmetric importation pattern has been analyzed as reflecting a native language ranking $*[si] \gg *[ti]$ (Itô & Mester 1995, 1997, 2001). However, because neither the native nor the foreign language data appear to motivate this ranking, the source of the ranking demands explanation. We argue that the $*[si] \gg *[ti]$ ranking reflects inherent universal differences in the perceptibility of the contrast between the foreign structures and the corresponding legal native structures. We provide experimental evidence that even speakers of English are better able to discriminate [ti/ʃi] than [si/ʃi], suggesting that the ranking $*[si] \gg *[ti]$ emerged naturally as Japanese speakers began to accurately perceive foreign [ti] while still failing to perceive foreign [si] as distinct from the legal native structure [ʃi].

The second puzzle posed by the Japanese adaptation patterns concerns the choice of repair for [ti] and [si] sequences, designated the *too-many-solutions* problem (Kang 2011, following Steriade 2001) or the problem of *differential faithfulness* (Broselow 2009). Although a few loanwords exhibit change to a non-palatalizing vowel (*spaghetti* > [supagettee]; Itô & Mester 1995, 1997, Crawford 2007, 2008, 2009), the far more common pattern involves palatalization of the consonant (*team* > [ʃiimu]). Japanese native vocabulary, where dental stops and fricatives are regularly palatalized before [i], motivates a native language ranking IDENT-V >> IDENT-C, a ranking that will account for the adaptation pattern as well. However, Kenstowicz (2007) has suggested that this ranking reflects a universal preference, based in perceptual asymmetry. On this view, the P-Map (Steriade 2001, 2009) projects universal rankings of

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¹We follow Crawford 2009 in using [ʃ] and [ʒ] to represent the postalveolar sounds (represented by Itô & Mester as [č] and [š]), although the Japanese postalveolar fricative, which differs in some respects from the English postalveolar fricative (Li et al. 2007), is more accurately represented as [ç]. We also follow Crawford in using the term ‘palatals’ rather than ‘postalveolars’ or ‘alveopalatals’ and follow common practice in representing [ɯ] as [u].

faithfulness constraints designed to maximize the perceptual similarity between inputs and outputs. Thus, [ti]/[si] are, by hypothesis, perceptually closer to [tʃi]/[ʃi] than to [te]/[se]. We will argue against this claim, presenting experimental evidence that is not consistent with the proposed perceptual asymmetry as well as cross-linguistic data demonstrating that the preference for consonant palatalization over change in vowel height is not universal. We conclude that while the acceptance of [ti] vs. [si] is rooted in universal perceptual asymmetries, the choice of repair strategy is a reflection of the Japanese native grammar rather than a reflection of universal perceptual similarity relationships.

2. M >> M: Differential difficulty

2.1. [ti] vs [si]

In native Japanese vocabulary, [t,d] and [s,z] have palatalized variants which appear only before the high front vowel [i]. The alternations are illustrated in the verbal forms in (1):

(1) Japanese verbal forms

	negative	volitional
'win'	[kat-anai]	[katʃ-itai]
'lend'	[kas-anai]	[kaʃ-itai]

Loanwords such as [tʃiimu] 'team' and [ʃiifuudo] 'seafood' demonstrate that palatalization of stops and fricatives is found in foreign-origin as well as native vocabulary. However as Crawford (2008, 2009) establishes, while [t] was routinely palatalized before [i] in loanwords that entered the language before about 1890, [ti] tends to be preserved in words borrowed after about 1930. While a convention for representing [ti] in *katakana* (using the characters for *te-i*) is "attested from at least the mid-19th century" (Crawford 2009: 38), "some non-native patterns, such as unpalatalized /s/ before /i...have not even acquired a conventional representation in *katakana* until recently" (Crawford 2009: 40-41). Furthermore, pronunciation of [si] often poses a problem for Japanese speaking learners of English.

Itô & Mester (1995, 1997, 2001) identify different lexical strata each associated with particular restrictions on phonological structure, and point out that in words of the same stratum, preservation of [ti] may coexist with palatalization of [s] before [i] (as illustrated by [ʃitibanʃku] 'Citibank'), but palatalization of [t] before [i] implies that [s] must palatalize in the same context. They account for these and other differences across strata by proposing that each stratum is associated with a cophonology that imposes its own ranking of constraints. The variation among these cophonologies is restricted, in that rankings of markedness constraints remain constant across all strata; only the rankings of faithfulness constraints may vary, with faithfulness constraints that are low in core strata ranked higher in more peripheral strata. In the core (Yamato and Sino-Japanese) strata, the markedness constraints *[SI] and *[TI] dominate the relevant faithfulness constraints, as they do in the stratum associated with fully assimilated foreign words, while faithfulness outranks these markedness constraints for unassimilated loanwords. The intermediate stratum, in which [ti] but not [si] appears, has the faithfulness constraints ranked between the two markedness constraints:

(2) Lexical strata

a. fully assimilated:	*[SI] >> *[TI] >> FAITHFULNESS (<i>city</i> > [ʃitʃi])
b. partially assimilated:	*[SI] >> FAITHFULNESS >> *[TI] (<i>city</i> > [ʃiti])
c. unassimilated:	FAITHFULNESS >> *[SI] >> *[TI] (<i>city</i> > [siti])

The source of the ranking *[SI] >> *[TI] is not obvious, since both [si] and [ti] are unattested in native vocabulary, and both are present in foreign vocabulary; thus, the only evidence for this ranking is the loanword data, which would not have been available to adapters at the initial stages of language contact. Itô & Mester (1999) propose that the M>>M ranking is not necessary in the native grammar, but instead emerged over time as speakers were exposed to the faithful mapping /ti/ > [ti], triggering demotion of *[TI] below the relevant faithfulness constraint(s). However, the question of why the faithful mapping /ti/ > [ti] should have been more prevalent than the the faithful mapping /si/ > [si] still demands an answer. Note that this problem remains even if one assumes loan-specific faithfulness constraints which may rank

independently of general faithfulness constraints (as in Crawford 2009), since the ranking of the loan-specific constraints would still need to be explained.

The *[sI] >> *[TI] ranking could plausibly have emerged if Japanese speakers had more frequent exposure to [ti] than [si]. However, an initial investigation points in the opposite direction; in a count of borrowed words in Arakawa's (1977) loanword dictionary, Crawford (personal communication) found 124 loanwords corresponding to English words beginning with [si] but only 23 corresponding to English words beginning in [ti]. Crawford reports more English [di]-initial borrowed words (40) than [zi]-initial borrowed words (6), but even considering voiced and voiceless forms together, the frequency of the total stop-initial words (63) is considerably smaller than the frequency of fricative-initial words (130). Thus, we cannot find evidence that at the point of initial contact with English, Japanese speakers were exposed to significantly more words containing [ti] than [si]. Nor can it be assumed that the *[sI] >> *[TI] ranking represents a universal default which speakers assume *a priori*. There is no clear evidence for a cross-linguistic implicational markedness relationship between palatal coronal stops and fricatives; Bateman's (2001) survey identifies the class of stops and fricatives as most likely to undergo palatalization, but does not subdivide this class. Furthermore, at least one language, Lauan Fijian, has been reported to require the opposite ranking, palatalizing [t] but not [s] before [i] (Kenstowicz 2007). Thus, if this ranking is neither motivated by the data to which Japanese speakers were exposed nor universal, the ranking poses a learnability problem.

An intriguing articulatory-based explanation for the relatively early acceptance of [ti] by Japanese speakers is offered by Shaw (2007) and Shaw and Balusu (2010), who argue that [ti] already existed in the Japanese repertoire as an articulatory variant of [tʃi]. They present evidence that the duration of the fricative portion of [tʃ] is shorter in weaker prosodic positions, such as unaccented syllables, where they find variants closer to [ti]. However, since the focus of these studies is only on [ti], no comparative data is presented that would establish a lack of overlap between English [s] and Japanese [ʃ]. Furthermore, the assumption underlying this explanation for the ready acceptance of [ti]—that learning a new contrast is facilitated when a single native language category encompasses phonetic variants corresponding to the discrete foreign language categories—is hard to reconcile with the body of evidence that in perception, at least, the mapping of the variants of a single native language category (e.g., the Japanese liquid) onto separate foreign language categories (e.g., English /r-/l/) is one of the most difficult tasks for the language learner (e.g., Flege 1987, Escudero 2005).

We propose that the ranking *[sI] >> *[TI] emerged not from frequency asymmetries, universal preferences, or articulatory familiarity, but rather from a language-independent asymmetry in the perceptual salience of the contrasts [ti-tʃi] and [si-ʃi]. In order for Japanese speakers to have realized that either of the markedness constraints was violated in foreign words, they first needed to accurately perceive the violating structure as distinct from a legal native language structure—that is, to realize that English [ti] and [si] were distinct from Japanese [tʃi] and [ʃi]. That Japanese speakers should recognize the distinction [ti]-[tʃi] more easily than [si]-[ʃi] is plausible, given that [t] and [tʃ] differ in the presence of frication as well as in place, while [s] and [ʃ] differ only in place.² Thus, it seems reasonable that upon exposure to English, Japanese speakers might have recognized English [ti] as distinct from Japanese [tʃi] well before distinguishing English [si] from Japanese [ʃi].

2.2. Experiment One: Perceptibility of [ti-tʃi] and [si-ʃi] contrasts

In this section we present experimental evidence supporting the hypothesis that the [ti-tʃi] contrast is inherently more perceptible than the [si-ʃi] contrast, not only for Japanese speakers, but also for speakers of English. The evidence comes from an experiment that was originally designed to investigate whether Japanese speakers' ability to distinguish these two contrasts would be affected by cues to stratal affiliation. This experiment built on work by Moreton and Amano (1999) demonstrating that Japanese speakers' perceptual category boundaries may shift when a sound is placed in a context that identifies a nonce word as of either native or foreign origin. Moreton and Amano created nonce forms of the shape *CoCV*, where

² Furthermore, the major acoustic characteristic distinguishing English [s] and [ʃ], centroid frequency, does not play an obvious role in Japanese, where the allophones [s] and [ʃ] ([ç]) differ mainly in the frequency of F2 onset (Li et al. 2007).

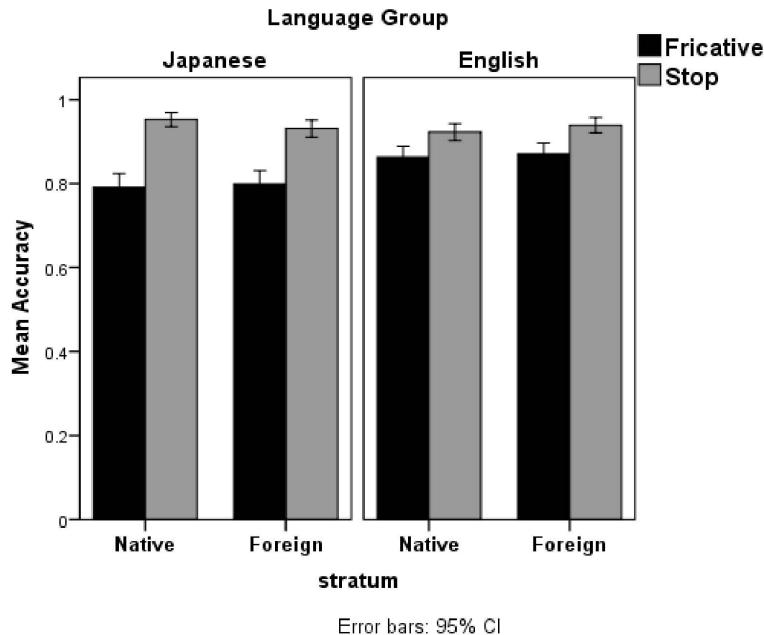
V was ambiguous between a long and short low vowel, and asked listeners to identify the nonce form as either *CoCa* or *CoCaa*. Each stimulus contained consonants which were restricted to either Sino-Japanese or foreign-origin words, thereby signaling that the word belonged to a specific stratum. Since a vowel length contrast in word-final low vowels is possible only in foreign-origin vocabulary, it was expected that the cues to stratal affiliation would affect the identification of the vowel as short or long. The results revealed that indeed, the same vowel stimuli that were identified as long in foreign-cue contexts were often identified as short in native-cue contexts, consistent with the illegality of final long [aa] in native vocabulary.

Our experiment was designed to determine whether the discrimination of the [ti-ʈʰi] contrast is similarly affected by contextual cues to stratal affiliation. The faithful preservation of [ti] in many borrowed forms has introduced the possibility of a [ti-ʈʰi] contrast, but only in foreign-origin vocabulary. If listeners tailor their perceptual strategies to different strata, attending only to the differences that are linguistically significant in that stratum, then Japanese speakers' accuracy in distinguishing these structures should vary according to contextual cues signaling stratum membership. At the same time, since [si-ʃi] is not an established contrast in either native or foreign origin vocabulary, discrimination of the fricative contrast should not be affected by contextual cues.

19 Japanese native speakers (8 male, 11 female) participated in the study, 13 in Japan and 8 in the US. All had no or very limited English proficiency. As controls, 22 monolingual speakers of English were recruited at Stony Brook University. None of the participants reported any hearing difficulties.

The stimuli consisted of trisyllabic nonce forms with LHH pitch accent, produced by a Japanese-English female bilingual. The first syllable contained cues to stratum ([hja]=Native, [ɸa] (corresponding to English [fa])=Foreign; Moreton, Amano, and Kondo 1988). The second syllable contained the target structures ([ti/ʈʰi, si/ʃi]), while the third syllable was stratum-neutral ([ro] or [re]). Intensity was scaled to 67dB, the average intensity of all the stimuli (2 strata x 2 manners (stop/fricative) x 2 places (dental/palatal) = 8). An ABX paradigm was used (8 stimuli x 4 orders, ABB, ABA, BAA, BAB = 32), for example, [hjatire]-[hjatʰire]-[hjatire] or [ɸasiro]-[ɸaʃiro]-[ɸaʃiro]. The interstimulus interval (ISI) was 500 ms. Order was randomized for each participant using E-Prime software (v2.0; Psychological Software Tools).

Written instructions (presented on a computer screen in their native language) directed participants to indicate whether the third form was the same as the first or second by pressing the appropriate key. After an 8-trial practice, participants had the opportunity to ask questions before proceeding to the actual experiment, which lasted approximately 20 minutes, with a break between the two blocks. Stimuli were presented binaurally over headphones at a comfortable listening level. Listeners heard each of the 32 trials twice in each of the 2 blocks (32 x 2 repetitions x 2 blocks = 128), and had 4000 ms to respond before the next trial began. Results are shown in Figure 1.

Figure 1. Discrimination accuracy by stratal context

If the stratum effect on identification of ambiguous stimuli revealed in the Moreton and Amano study extended to the discrimination of sound differences, we would have expected that when the context marked the words as foreign-origin, the Japanese speakers should more accurately discriminate [ti] vs. [tʃi], since it is only in foreign-origin words that such a contrast is possible. For each language group, a repeated measure ANOVA was performed with Stratum (Native vs. Foreign) and Manner (Fricative vs. Stop) as within-subject factors.

As Figure 1 illustrates, the Japanese speakers' discrimination of the [ti-tʃi] contrast was not affected by stratal cues: discrimination of this contrast was equally good in both stratal contexts, suggesting that this contrast has become established in their perceptual system. The results also show that Japanese speakers performed significantly better in discriminating [ti-tʃi] than [si-fi], regardless of stratum ($F(1,18) = 33.34, p = .00$). The asymmetry in the Japanese speakers' discrimination of [ti-tʃi] vs. [si-fi] is not surprising, given the fact that [si] appears only in unassimilated foreign words.³ The surprising result, however, is that English speakers also showed significantly better discrimination of [ti-tʃi] than of [si-fi], as confirmed by a significant main effect of Manner ($F(1,21) = 15.88, p = .001$) and no significant interaction of Manner with Stratum. This asymmetry appears even though both contrasts are well established in English.⁴

The English speakers' relatively poorer performance in discriminating [si-fi] than [ti-tʃi] supports the hypothesis that the latter contrast is inherently easier to perceive. This suggests a scenario in which the ranking $*[sI] \gg *[tI]$ emerges quite naturally. We can assume that the Sino-Japanese grammar imposed

³We are indebted to Yu Tanaka for pointing out a possible explanation for the lack of a stratum effect: that these forms may actually not have sounded native to Japanese speakers, because initial [hja] is rare in Japanese and is always followed by either [k] or [pp].

⁴To determine whether this could have been an effect of the speaker, we carried out a followup experiment in which English speakers both discriminated and provided goodness ratings for the [ti, tʃi, si, fi] tokens of the bilingual Japanese-English bilingual from the ABX experiment and the same tokens produced by a monolingual English speaker. All four structures were accurately discriminated by the English speakers, and while the bilingual speaker's [fi] was rated significantly lower than the monolingual speaker's [fi], her [tʃi] was also rated significantly lower than the monolingual speaker's [tʃi]. Thus no correlation between goodness rating and discriminability was found across the stops and fricatives.

no relative ranking between the two markedness constraints, both of which dominated the relevant faithfulness constraints. With exposure to foreign structures, the distinction between foreign [ti] and Japanese [tʃi] was perceived relatively early, motivating demotion of *[Tɪ], while the perceptual assimilation of English [si] to Japanese [ʃi] persisted. This view is consistent with the findings of Li, Munson, Edwards, Yoneyama, and Hall (2011) that Japanese listeners exposed to fricative stimuli were likely to assimilate “ambiguous or intermediate speech sounds” to the <sh> category, in contrast to English speakers, who assigned these sounds to the <s> category. This is also consistent with the model proposed by Crawford (2009), who points out that even if the initial adapter produces a foreign structure faithfully, this pronunciation may be misperceived by members of the community in the process of transmission. We argued that such misperception is more likely in the case of [si] than [ti], and that with increasing exposure to foreign forms, this asymmetry led listeners to demote one markedness constraint while leaving the other undominated.

2.3. Extensions of the perceptual asymmetry account: Jamaican Creole

Another case of differential difficulty comes from Jamaican Creole, which embodies distinct speech registers associated with specific phonological restrictions:

(3) Jamaican Creole registers: ‘that stick’ (Meade 2001, Itô & Mester 2001)

acrolect:	[ðat stik]
mesolect:	[dat stik]
basilect:	[dat tik]

Meade (2001) identifies an implicational relationship between the two structures that are part of the acrolect but not the basilect: “a speaker whose language competence allows her to regularly produce dental fricatives in a particular context can be assumed to also regularly produce /s/-stop clusters in equivalent contexts (Meade 2001: 46). This asymmetry can be described by means of the ranking *[ð] >> *[sT] in the cophonology associated with the mesolect (Meade 2001, Itô & Mester 2001).

An account of this ranking in terms of the greater salience of the [stV]-[tV] contrast vs. the [ð]-[d] contrast seems eminently reasonable. Sibilants are among the most salient sounds of language, so the presence vs. absence of [s] should be easily discriminable. In contrast, the [ð]-[d] contrast is quite subtle; (Polka, Colantonio, & Sundara 2001) showed that both Francophone and Anglophone children of 6-8 months and 10-12 months showed relatively poor discrimination of this contrast, and Moroson and Jamieson (1989) showed that after training, adult Canadian Francophones who became relatively successful in distinguishing [θ]-[ð] were still unable to consistently distinguish [ð]-[d]. Thus, we can assume that the mesolect ranking *[ð] >> *[sT] arose naturally as speakers of a language that lacked both structures were exposed to both but initially perceived violations only of *[sT].

3. F>>F: Choice of repair

3.1. Consonant change vs. vowel change

We turn now to the question of why, when [ti], [si] were adapted to legal Japanese sequences, this adaptation took the shape of change in the consonant rather than change in the vowel. All non-foreign words (Yamato, Sino-Japanese, and Mimetic) in Japanese conform to strict restrictions on the distribution of coronal consonants: dental consonants [t, d, s, z] may not occur before [i], while palatal consonants [tʃ, dʒ, ʃ, ʒ] may not occur before [e]. In addition to the markedness constraints *[sɪ], *[Tɪ], Itô & Mester (1995) propose a constraint *[ĈE] banning palatals before mid front vowels. Two obvious strategies exist for adapting foreign sequences that violate these constraints: changing the consonant (palatalization before [i], depalatalization before [e]) or changing the vowel (lowering of [i] after a non-palatal consonant, raising of [e] after a palatal consonant). Both types of repair are actually attested in established loans:

(4) Repairs in CV sequences (Itô & Mester 1995, 1999; Crawford 2009)

- a. C-[i], palatalization of C
[tʃiimu] ‘team’; [dʒiremma] ‘dilemma’; [ʃinema] ‘cinema’
- b. C-[i], lowering of V
[teʃʃu] ‘tissue’; [deɖʒitaru] ‘digital’
- c. C-[e], depalatalization of C
[sero] ‘cello’; [zene-suto] ‘general strike’; [sepaado] ‘shepherd (dog)’
- d. C-[e], raising of V
[tʃikki] ‘check’ (~ more common [tʃekki, tʃekku], Crawford 2009: 72)

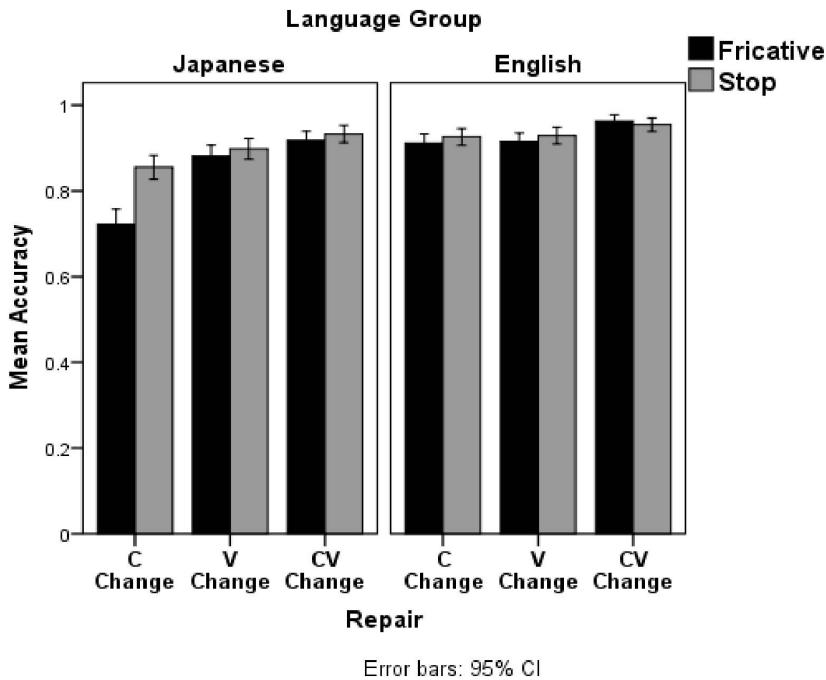
However, as Crawford (2009) establishes, a change in vowel height is exceedingly rare, while a change in consonant place (palatalization or depalatalization) is the norm for both Ci and Ce sequences.

The tendency to palatalize a consonant before [i] is not surprising, given that the native vocabulary contains productive alternations such as [kat-anai]/[kaʃ-itai], [kas-anai]/[kaʃ-itai] (as illustrated in (1) above). The native language data therefore motivate a ranking of faithfulness constraints which favors maintenance of vowel features over maintenance of consonant place. Crawford accounts for the possibility of variability in loanwords as opposed to the consistency of native patterns by assuming (following much earlier research in loan adaptation) a set of loan-specific output-output faithfulness constraints which compare loanword outputs to the foreign form. These constraints may be ranked independently of the input-output faithfulness constraints that govern native vocabulary. If we allow the possibility of loan-specific faithfulness constraints, the appeal to the native language ranking of general input-output faithfulness constraints is not a sufficient explanation for the preference for C change over V change, since the loan-specific constraints could in principle be ranked independently of the general constraints. The evidence for the ranking of the loan-specific constraints could come only from the loanword data, returning us to the problem of why the original adapters would have chosen this ranking. The learnability problem disappears, however, if there is reason to believe that IDENT-V >> IDENT-C represents a default ranking of faithfulness constraints of any type. Precisely this claim is made by Kenstowicz (2007), who concludes from an investigation of both Fijian and Japanese loanword adaptation that “In the present context where palatalization of /t/ is the universally preferred solution to a prohibition against *[ti] (change the consonant, not the vowel), we must infer that the change of /ti/ to [tʃi] is less noticeable than the change of /ti/ to [te]. This implies that the stimulus pair [ti]-[tʃi] should be judged more similar than [ti]-[te]...Hence, we infer the fixed ranking: Ident-[pal]V/tʲ >> Ident-[pal] C/_i” (Kenstowicz 2007: 332).

3.2. Experiment Two: Perceptibility of repairs

We carried out an experiment designed to test the hypothesis that palatalization of the consonant in a [ti] or [si] sequences creates a smaller perceptual change than lowering of the vowel. The participants were the same 19 Japanese native speakers and 22 English speakers who participated in the first experiment and the stimuli were produced by the same Japanese-English bilingual speaker. The stimuli consisted of trisyllabic nonce forms with LHH pitch accent. The target sequences ([ti/tʃi/te] or [si/ʃi/se]) occurred in the initial syllable and were followed by two filler syllables ([make/mike/moke/beki]). The intensity of the stimuli was scaled to 67 dB, the average intensity of all stimuli (3 targets x 2 manners x 4 fillers = 24). An ABX paradigm was used (24 stimuli x 4 orders = 96 trials x 2 blocks = 192 trials) with an ISI of 500 ms. The procedure was the same as in the first experiment. Figure 2 shows respondents’ accuracy in discriminating [ti/si] vs. [tʃi/ʃi] (C change); [ti/si] vs. [te/se] (V change); and [ti/si] vs. [tʃe/ʃe] (CV change).

Figure 2. Discrimination accuracy by repair type



Unsurprisingly, discrimination was most accurate for both Japanese and English speakers when both consonant and vowel changed, for both stops and fricatives. The interesting comparison comes in the discriminability of [ti] and [si] with respect to the two single repairs, C change vs. V change. Recall Kenstowicz's (2007) hypothesis concerning perceptual similarity:

(5) Perceptual Similarity Hypothesis (Kenstowicz 2007)

- a. $\Delta[\text{ti}]-[\text{tʃi}] < \Delta[\text{ti}]-[\text{te}]$
- b. $\Delta[\text{si}]-[\text{ʃi}] < \Delta[\text{si}]-[\text{se}]$

We consider first the results involving [ti] stimuli. Contrary to the predictions of the perceptual similarity hypothesis, neither the Japanese nor the English speakers showed a significant difference in their ability to discriminate [ti-tʃi] vs. [ti-te]. Thus, these results did not support the claim that adapters choose the C change over the V change because the C change is inherently less perceptually salient, regardless of native language.

The English speakers' responses to [si] stimuli are also not consistent with the perceptual similarity claim, as the English speakers discriminated both sets equally well. However, the Japanese speakers showed a different pattern, discriminating [si-se] significantly more accurately than [si-ʃi] ($p=.001$). These results are as predicted by Kenstowicz's (2007) hypothesis that C change is less perceptually salient than V change. However, this is the only one of the four comparisons that is consistent with the predictions of this hypothesis.

We assume that the asymmetry in the discrimination of [si]-[ʃi] vs. [si]-[se] reflects the facts of the native language. In Japanese, the difference between [s] and [ʃ] is never contrastive; listeners can predict the place of a coronal fricative based entirely on the vocalic context. The [i]-[e] contrast, however, is linguistically significant in a wide range of consonantal contexts, and therefore it makes sense that Japanese speakers would attend more strongly to the vocalic difference.

The fact that the Japanese speakers did equally well in discriminating [ti-tʃi] and [ti-te] is also consistent with the facts of the native language: the importation of [ti] means that the identity of a coronal

stop can no longer be predicted from the vocalic context. Thus, Japanese speakers seem to do better at discriminating contrasts that are critical to lexical retrieval.⁵

We conclude, then, that the ranking IDENT-V >> IDENT-C, required to describe the overwhelming Japanese preference for changing the palatality of the consonant, reflects the influence of the native language rather than a ranking projected by a universal P-map.

3.3. Cross-linguistic choice of repair

If the Japanese preference for C change over V change to repair illegal CV sequences does not represent a universal preference, we should expect languages to have the option of satisfying native CV restrictions like those of Japanese by changing the vowel rather than the consonant. Indeed, the Niger-Congo language Nupe appears to avail itself of the vowel change option. In Nupe, dental consonants [s, z, t̪, d̪] are banned before front vowels ([i, e, ε]), while their palatal counterparts [ʃ, ʒ, tʃ, dʒ] occur only before front vowels (and [a], which may be preceded by either type of coronal). Hyman (1970a,b) reports that words borrowed into Nupe from Yoruba and Hausa are altered to satisfy the CV place restrictions. However, Hyman's loanword data show a pattern that differs from the Japanese loanword repair strategy; while an original dental consonant is palatalized before [i], a vowel is fronted following an original palatal consonant:

(6) Japanese vs. Nupe repairs

a. Japanese

C change: [si] > [ʃi] (*seafood* > [ʃifuudo])

C change: [ʃe] > [se] (*shepherd* > [sepaado])

b. Nupe

C change: [si] > [ʃi] (Yoruba [sisi] > [ʃiʃi] 'sixpence')

V change: [ʃu] > [ʃi] (Hausa [ʃùgàbà] > [ʃigàbā] 'leader')

[ɔʒu] > [ɔʒi] (Hausa [ɔʒúmmáʔà] > [ɔʒímâ] 'Friday')

In his discussion of the vowel change repair in Nupe, Hyman proposes an explanation based in perception: "one must ask why the consonant remained as in Hausa with the vowel altered, rather than the vowel remaining with the consonant altered...It must mean that the palatalization of the initial sound has caused the Nupe speaker to perceive the vowel [u] as [i], the corresponding front vowel that would make palatalization possible" (Hyman 1970a: 30).

We must then ask why Japanese speakers do not exhibit the same misperception as Nupe speakers, rendering 'shepherd' as [ʃipaado]. One difference between the cases involves the features of the triggering vowels, but this seems unlikely since in the Nupe case the vowel changes two features, backness and roundness, while a similar change in Japanese would involve only a single change, in vowel height. Another possible explanation lies in the morphological systems of the two languages. In Japanese, the existence of obstruent-final roots such as /kat/, /kas/ which take a range of vowel-initial suffixes means that the dental-palatal relationship is supported both by distribution (static constraints over the lexicon) and by alternations, in which a single morpheme appears with a dental in one context and a palatal in another context. Nupe, in contrast, seems to be built on a system of vowel-final roots, so that context in which obstruents appear is generally constant, lacking opportunities for dental-palatal alternations.

Another candidate for a case in which the segmental affiliation of a palatal feature is misinterpreted comes from the adaptation of French [Cy] sequences by speakers of Russian. Russian speakers, whose native language lacks front rounded vowels, typically adapt French [Cy] sequences as [C'u], retaining the

⁵The alert reader will be asking why the English speakers did not show here the same asymmetric discrimination of [ti-tʃi] vs. [si-ʃi] that emerged in the first experiment. We hypothesize that this is due to a difference in difficulty caused by different experimental conditions. In experiment two, the relevant contrasts appeared in word-initial position, while in the first experiment, the contrast appeared in medial position and followed a syllable that would have been unfamiliar to English speakers ([hja] or [ɸa]). The greater difficulty of the task in the first experiment therefore uncovered a difference in discriminability that did not emerge in the first experiment, where participants were operating at ceiling.

rounding of the vowel but preserving its frontness as palatalization on the consonant (Paradis & Thibault 2004, Paradis 2006, Padgett 2010). In this case, both consonant and vowel undergo changes in palatality. Systematic cross-linguistic investigation is warranted to determine the extent to which palatal features are preserved in loanword adaptation and the various strategies employed in this preservation.

4. Conclusion

Our goal in this paper was to determine the source of the constraint rankings required to account for loanword adaptation patterns. The relatively early preservation of [ti] alongside the persistent nativization of [si] to [ʃi] can be described by a ranking of the constraint banning [si] above the constraint banning [ti]. But since the evidence for this ranking comes exclusively from the loanwords, it was not clear why it should either have been present in the native grammar or have emerged in initial stages of language contact. We argued that the source of this ranking lies in perceptual asymmetry: Japanese speakers were able early on to perceive the foreign structure [ti] as distinct from the corresponding native structure [ʃi], and therefore were motivated to demote *[TI], while the foreign structure [si] was much more likely to be misperceived as native [ʃi]. The greater discriminability of the [ti-ʃi] vs. the [si-ʃi] contrast was argued to be independent of the native language, reflecting differences in the inherent robustness of the acoustic cues to the contrasts. We also considered the preference for repairing illegal CV sequences by means of consonant change rather than vowel change. For this pattern we rejected a perceptually based approach, arguing that the faithfulness ranking IDENT-V >> IDENT-C is rooted in the grammar of Japanese.

Numerous problems in the adaptation patterns of Japanese remain to be explained—for example, the role of voicing in both differential importation and differential repair. Crawford (2009) reports that [ti] and [di] show somewhat different histories, with the preservation of [di] becoming predominant somewhat earlier than the preservation of [ti]. This asymmetry has no obvious explanation in terms of perceptual asymmetry. Another puzzle involves affrication of dental stops before the high back vowel. In native vocabulary, [t] becomes [tʃ] before [u], while [d] becomes [dʃ] in initial or postnasal positions and [z] intervocalically (/tuki/ > [tʃuki] ‘moon’; /kaNduki/ > [kaNduki] ‘cold month’; /mikaduki/ > [mikazuki] ‘increasing moon’; Shinohara 2004). The affrication of [t] in [tu] sequences appears to be quite persistent, even though the contrast between [tu] and [tsu] would seem to be salient (Junko Itô, personal communication). Furthermore, Shinohara (2004) points out that [tu] and [du] sequences commonly undergo different repairs in loanword adaptation. In older loanwords, [tu] sequences are repaired by affrication of the consonant (*Toulouse* > [tʃuuruuzu]; *two-piece (bathing suit)* > [tʃuupiisu]), while [du] is repaired by lowering of the vowel (*Pompidou* > [poNpidoo]), a pattern that she analyzes by means of the ranking *[DZ] >> IDENT-[high] >> *[TS]. The question of how speakers arrived at just this ranking, given access only to data from the native and the foreign languages, is another of the intriguing puzzles posed by loanword phonology.

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