

The Role of Loanword Diffusion in Changing Adaptation Patterns: A Study of Coronal Stops in Japanese Borrowings*

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Optimality-Theoretic analyses of loanword phonology account for the phonological adaptations seen in loanwords using one of two mechanisms: markedness constraints in the phonology of L1 speakers, and perceptual biases affecting the input. However, while these analyses may be able to account for the synchronic behavior of a single speaker in borrowing a particular loanword, they cannot easily account for the systematic change over time in loanword adaptation patterns seen in a speech community that is becoming more bilingual in L2. After examining the adaptation patterns affecting coronal stops before high front vowels in Japanese loanwords, I will argue that the nativization of [ti] and [di] sequences in early loans was not caused by a highly ranked markedness constraint forbidding these sequences, but rather emerged from the cumulative misperceptions and misproductions of loanwords containing [ti] and [di] as they spread throughout the Japanese speech community.

1. Introduction

Loanword phonology has traditionally posed a problem for rule-based theories of phonology, since they typically require loanword-specific rules, which are otherwise unmotivated in the native phonology, to account for the adaptation patterns seen in borrowings. However, since the publication of Yip (1993), there have been many analyses of loanword phenomena using the mechanisms of Optimality Theory (Ito and Mester 1995, 1999; Davidson and Noyer 1996; Broselow 2004; *inter alia*) as well as other constraint-based approaches (Paradis and LaCharité 1997, LaCharité and Paradis 2005). These analyses generally argue that loanword adaptation patterns occur during the production of a loanword token, and are driven by the interaction between faithfulness to the source language form and markedness constraints of the borrowing language. An alternative approach, also couched within the OT framework, focuses instead on the role of perception, specifically on the parsing of non-native phonetic patterns in terms of the native phonology (Kang 2003, Iverson et al. 2003, Peperkamp 2005).

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An example of a production-based analysis is Katayama (1998)'s account of the adaptation of English words borrowed into Japanese containing word-final consonants. Since Japanese does not generally allow segments to appear in syllable codas,¹ these illegal consonants must be repaired in some way, and the usual repair strategy is to insert an epenthetic vowel,² allowing the consonant to be syllabified in onset position. Katayama explains this adaptation pattern by ranking the constraints *CODA (no coda consonants) and MAXIO (no deletion) above DEPIO (no epenthesis), as in Table 1.

/baik/	*CODA	MAXIO	DEPIO
a. bai		*!	
b. baik	*!		
c.  bai.ku			*

Table 1: Adaptation of 'bike' as [baiku], based on Katayama (1998)

While this sort of argumentation is common in the OT literature on borrowing, there are a couple of unstated assumptions being made here with regards to the adaptation process itself:

1. Since the constraints used for the native phonology are also used in loanword adaptation, and since all speakers of the borrowing language should have exactly the same ranking of constraints for the native phonology, then any given speaker will use exactly the same repair strategies as any other speaker in adapting a particular loanword.
2. The phonological adaptation of a loanword is properly modeled as a process which takes place within the linguistic competence of a single idealized speaker, and not as a process involving the speech community as a whole. That is to say, if we consider the borrowing of a word to be made up of two stages, (a) the initial use of a new L2 word by a bilingual in L1 discourse, and (b) the subsequent establishment of that new word in the L1 speech community (c.f. Poplack,

¹ Excepting moraic nasals and the first part of a geminate.

² The actual vowel inserted depends on the coda consonant: usually /u/, but /o/ after a coronal stop /t/ or /d/, and /i/ after a palatal affricate /tʃ/ or /dʒ/ (but not after the fricative /ʃ/, which gets the default /u/).

Sankoff, and Miller (1988)'s distinction between *nonce* and *established* borrowings), then phonological adaptations take place during stage (a) only, and no further changes occur during stage (b).

These may be relatively safe assumptions to make when looking at borrowings in present-day Japanese, which has been in contact with English for over a century and which has developed over that period of time a set of well-known conventions for adapting words from English that are applied consistently to recent loans. However, the first assumption turns out not to hold when we look at older loans that are attested from before the 20th century, which often show a great deal of variation in adaptation patterns. For example, consider the early loan *ramune*, derived from the English word 'lemonade'³ and first attested in print in 1869, according to Arakawa (1977). Note that the final [d] in 'lemonade' was not preserved in *ramune*, suggesting that the speaker(s) who initially borrowed this word favored deletion over epenthesis as a repair strategy for coda consonants, and would have had a different ranking of MAXIO and DEPIO (DEPIO » MAXIO instead of MAXIO » DEPIO). One might argue that this is evidence for a reranking of MAXIO and DEPIO that took place over time; perhaps 19th-century Japanese speakers had the ranking DEPIO » MAXIO, while 20th- and 21st-century Japanese speakers have the ranking MAXIO » DEPIO. But it is unclear what would have caused this change, as there were no sound changes taking place in the native lexicon to motivate this reranking. Besides, there are similar borrowings from the same time period, such as *meedo* 'maid' dating from 1848 (Arakawa 1977), which do preserve the coda consonant. If we assume that the adaptations in *meedo* and *ramune* are both due to the ranking of faithfulness constraints with respect to *CODA, then the Japanese speakers who borrowed *meedo* must have had the ranking *CODA, MAXIO » DEPIO, while the speakers who borrowed *ramune* must have had the conflicting ranking *CODA, DEPIO » MAXIO, and these two groups of speakers would have coexisted during roughly the same time period,

³ *ramune* is not actually used to mean 'lemonade', however, but instead refers to a carbonated lemon-flavored drink. This difference in meaning probably helped it to survive in the face of the more recent borrowing *remoneedo*, also derived from 'lemonade'.

violating the assumption that all speakers (at a given time) have the same ranking of the relevant constraints involved in loanword adaptations. There must have been some sort of reconciliation of these conflicting repair strategies in the Japanese speech community over time, ending up with epenthesis now being the preferred strategy in the case of illegal coda consonants. But it is unclear how this reconciliation could be accounted for while making the second assumption above. An approach that only looks at the synchronic event of a single speaker computing an adaptation for a given loanword cannot easily explain or even describe diachronic processes taking place over the entire speech community.

In the case of *meedo* vs. *ramune* and other early coda-deletion borrowings, it may be possible to explain the variation in adaptation patterns as resulting from variation in the input. Specifically, there are many examples of pairs like *ramune* and *remoneedo* (a later reborrowing of 'lemonade') where one member of the pair is a spoken borrowing while the other is a written borrowing (Smith 2006), and perceptual strategies used by Japanese speakers would affect the input to spoken borrowings only, not written ones. Thus the non-occurrence of [d] in *ramune* may be the result of the misperception of [lɛmɔneɪd] as something like [lɛmɔne], and since there are no coda consonants present in the misperceived input there would be no need to make a repair in this case. Thus the output *ramune* can be derived with the same relative ranking of MAXIO and DEPIO that we used for cases like *baiku* in Table 1.

Yet while differences in the perceived input may be able to explain differences in adaptation patterns between spoken and written loans, there are other, more systematic cases of variation in early loans which cannot be so easily explained. I will now show that any approach to borrowing which explains loanword adaptations solely in terms of an individual speaker's phonological competence is necessarily incomplete, as it accounts neither for this systematic variation in adaptation patterns, nor for the later establishment of consistent adaptation strategies for non-native patterns. After looking at the patterns of variation in the adaptation of coronal stops before high front vowels in Japanese loans, I will then propose a different approach that examines the role of the transmission of loanwords among the members of a speech community in establishing adaptation

strategies. I will argue that these adaptations are not the result of markedness constraints being applied by a single speaker during the initial borrowing of a word, but rather stem from the cumulative misperceptions and misproductions of a loanword as it spreads from speaker to speaker.

/tiim/	*TI	MAXIO	IDENTIO[COR]
a. tiimu	*!		
b.  tʃiimu			*
c. iimu		*!	

Table 2: Adaptation of 'team' as [tʃiimu], showing the effects of *TI

2. Coronals before [i] in Japanese

In the native phonology of Japanese, the coronal obstruents [t], [d], [s], and [z] cannot occur before the high front vowel [i]. This constraint not only holds as a static generalization over possible word forms, but also governs morphophonemic alternations in verb conjugation patterns. For example, the final /t/ in the root /mat-/ 'wait' surfaces as [t] in a form like /mat+anai/ → [matanai] 'wait (neg.)', but as [tʃ] in /mat+imasu/ → [matʃimasu] 'wait (polite)'. Ito and Mester (1999) propose two markedness constraints, *TI (coronal stops cannot occur before /i/) and *SI (coronal fricatives cannot occur before /i/), to account for these patterns. While both of these constraints are inviolable for native words, there are some recent loanwords which can apparently violate *TI, such as *paati* 'party'⁴ and *direkutaa* 'director'. However, there are more nativized loans such as *tʃimu* 'team' which seem to show the effects of *TI, since the [t] from the English source word surfaces as [tʃ] instead of [t] (Table 2).

⁴ The form *paatʃi* for 'party' is also sometimes attested.

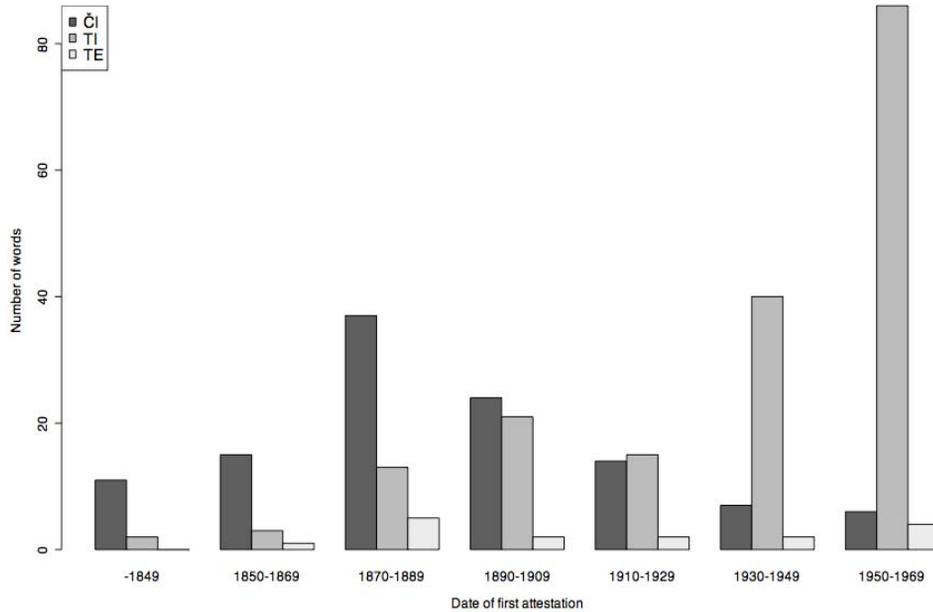


Figure 1: Adaptation patterns over time of *TI-violating loanwords

Finally, Ito and Mester argue that *SI is ranked more highly than *TI, because there are examples of loans which violate *TI but not *SI. For example, the word 'city' can be adapted as *siti* (which violates both constraints), *ʃitiʃi* (which violates neither constraint), or *ʃiti* (which violates *TI only), but the form **sitiʃi*, in which the /t/ is palatalized but the /s/ remains unpalatalized, is apparently unattested. Note, however, that the relative ranking of *TI and *SI can only be decided on the basis of loanword evidence, since neither constraint is ever violated in the native phonology.

The question arises as to what determines whether a given loanword obeys *TI or not. Ito and Mester suggest that this depends on the age of the loan, with older borrowings being more likely to show nativization with respect to *TI than younger ones. To look at this question in more detail, I consulted Arakawa (1977), a Japanese loanword dictionary which gives for each entry several citations from newspapers, literary works, and other texts dating from the time the loanword was first attested, as well as more recent attestations from the mid-20th century if the word was still in use. From this

dictionary I collected a set of 339 loanwords derived from source words containing a coronal stop followed by a high front vowel [i] or [ɪ] (both of which are adapted into Japanese as [i]). Figure 1 is a histogram comparing the most common adaptation pattern for each of these loans with the year they were first attested. One thing that is immediately striking is that the total number of new loanwords coming into the language has generally increased over time, with two discernible peaks occurring in the periods 1870-1889 and 1950-1969. These two peaks correspond with two significant events in Japanese history which increased Japanese contact with the outside world: the beginning of the modernization of Japan during the Meiji era, and the post-WWII occupation of Japan by the United States, respectively. As far as the individual adaptation patterns themselves, words first attested before about 1890 usually have [tʃi] corresponding to [ti] or [tɪ] in the source word (and [dʒi] corresponding to [di] or [dɪ]), while words first attested after about 1930 usually have [ti] instead for [ti] or [tɪ] (and [di] for [di] or [dɪ]), with a gradual shift from the TI → ČI to the TI → TI adaptation strategy⁵ taking place from 1870-1930. A third adaptation pattern, TI → TE, where the coronal stop is preserved but the vowel is lowered to [e], turns out to never be very common relative to the other two adaptation patterns, except for a slight peak during the period 1870-1889.

⁵ In discussing adaptations, I will use the notation TI to refer to either the set of four possible source sequences [ti], [tɪ], [di], and [dɪ] or the set of unnativized outcomes [ti] and [di], ČI to refer to the set of nativized outcomes [tʃi] and [dʒi], and TE to refer to the outcomes [te] and [de].

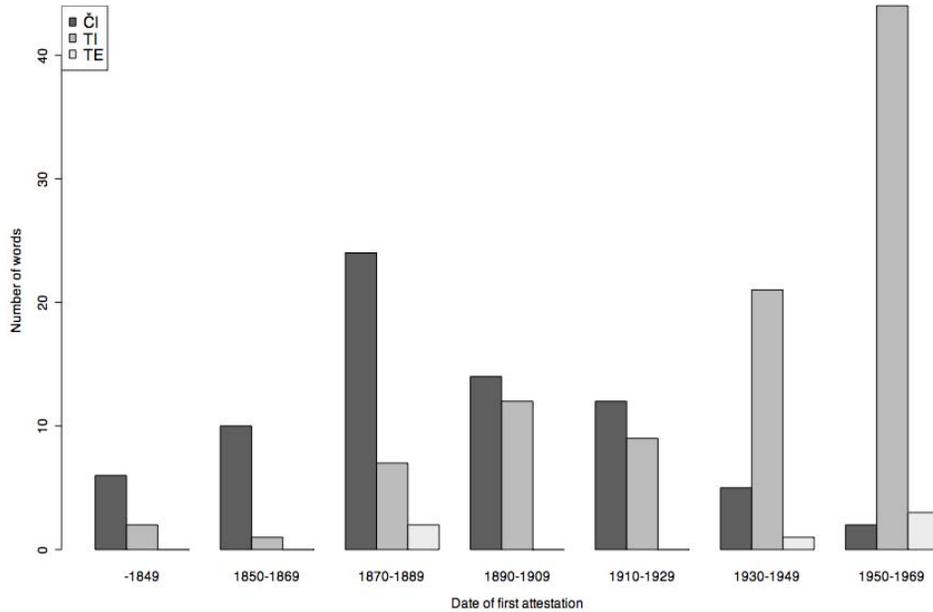


Figure 2: Adaptation patterns over time of source words containing /t/

While tokens of early *TI-violating loans which generally show the TI → ČI adaptation pattern are sometimes attested with the TI → TI adaptation pattern around the time they are first borrowed, tokens of more recent loans are almost always attested with the TI → TI adaptation pattern only, and these words show no sign of becoming more nativized over time. This suggests that there has been a change in the acceptability of TI sequences among Japanese speakers over time: mostly unacceptable before about 1890, variably acceptable from 1890-1930, and mostly acceptable after about 1930. What's more, this change in acceptability seems to be sensitive to the voicing of the stop in the source word, with loanwords derived from source words containing [t] being more likely than loans derived from words containing [d] to be nativized over the time period we are looking at. This can be seen by splitting up the loanword data by the voicing of the stop, as in Figures 2 and 3. The [ti, ti] → [tʃi] adaptation strategy was generally preferred over [ti, ti] → [ti] until about 1930, with a period of variation between [tʃi] and [ti] adaptations occurring from 1890 to 1930 (Figure 2). The [di, di] → [di] adaptation strategy, on the

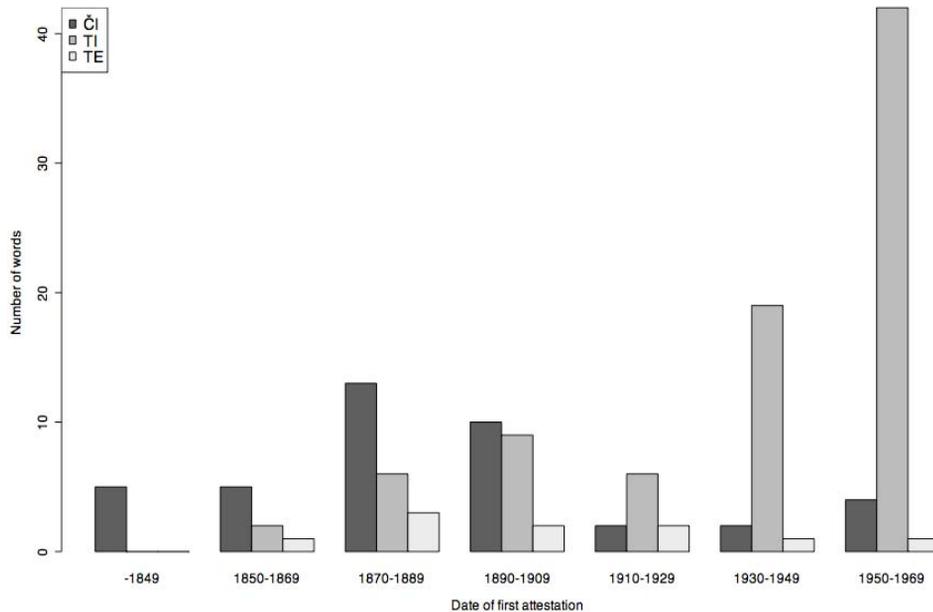


Figure 3: Adaptation patterns over time of source words containing /d/

other hand, came to be preferred over $[di, dɪ] \rightarrow [dʒi]$ at an earlier time, between 1910-1930, with variation between $[dʒi]$ and $[di]$ from 1890-1910 (Figure 3). The $[di, dɪ] \rightarrow [de]$ adaptation strategy was also more common than $[ti, tɪ] \rightarrow [te]$ in the late 19th and early 20th centuries, although it never ultimately became the preferred adaptation for either set of TI sequences.

There also seems to be a phonological neighborhood effect governing which adaptation strategy is likely to apply to a given loanword. For example, while words with $/-t + iv/$ in English (such as *active* or *creativity*) follow the general pattern for voiceless /t/ as being adapted as $[tʃi]$ before 1930 and $[ti]$ afterwards, words with $/-ti\#/$ (such as *city* or *humanity*) or $/-\{t,d\} + iŋ\#/$ (such as *wedding* or *batting*) were commonly adapted as $[ti]$ much earlier, starting around 1870 (Figure 4), while words with $/-tik(s)/$ (such as *statistics* or *mystic*, all containing the quasi-morphemic suffix *-ic*) were variably adapted as either $[tʃi]$ or $[ti]$ from 1900-1930 (Figure 5). In general, the set of environments in which TI sequences were acceptable in loanwords has gradually expanded over time: at

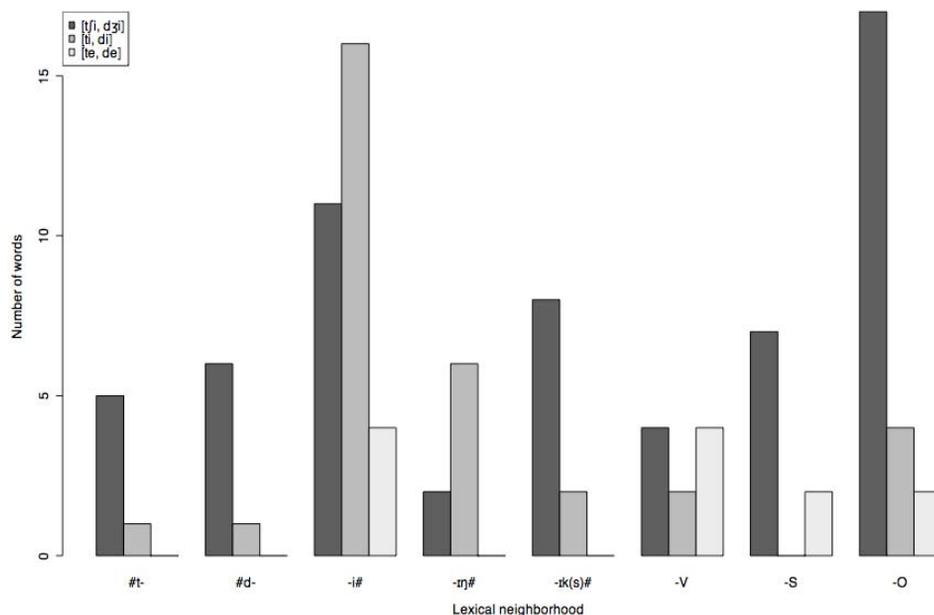


Figure 4: Adaptation patterns by phonological neighborhood for TI sequences in loanwords first attested 1870-1899. V=vowel; S=sonorant; O=obstruent.

first [tɪ] and [dɪ] were preserved only if they occurred in the source word in a word-final syllable with /i/ or /ɪŋ/, then [dɪ] from word-initial syllables and [tɪ] from word-final syllables with /ɪk(s)/ also began to be preserved, and finally [tɪ] and [dɪ] became acceptable in all other environments, which is the present day situation.

Thus, the adaptation patterns of TI sequences show a complex, yet systematic, pattern of variation over time, with a general trend towards acceptability of TI sequences being composed of smaller-scale changes sensitive to the voicing of the coronal stop and the phonological environment that the TI sequence occurs in. I will now examine how both markedness-based and perception-based analyses of loanword adaptation fail to adequately account for these patterns of variation.

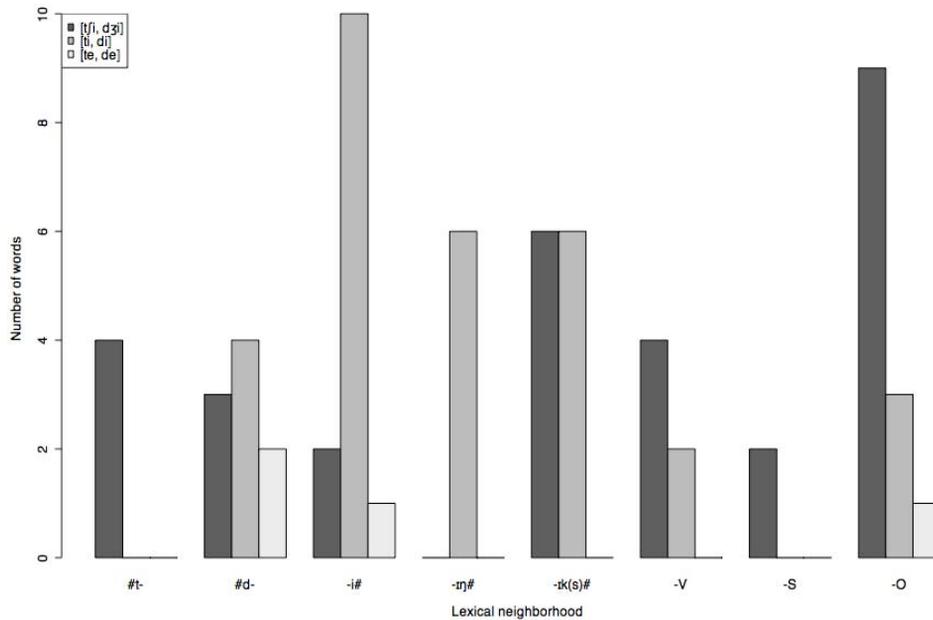


Figure 5: Adaptation patterns by phonological neighborhood for TI sequences in loanwords first attested 1900-1929.

3. A markedness-based account of coronal adaptation

While a change in the preferred adaptation strategy for a particular non-native pattern is not usually thought of as sound change per se, the growing acceptability of [tʃ] and [dʒ] during the late 19th and early 20th centuries can be considered a kind of contact-induced sound change, since it introduces a contrast (between alveolar stops and palatal affricates before /i/) which did not previously exist in modern Japanese. Thus, following Jacobs (1995) and other OT accounts of sound change, the shift in preferred adaptations over time can be explained as resulting from the reranking of the relevant markedness constraints with respect to faithfulness. Specifically, the general trend towards acceptability of TI sequences shows that *TI was ranked highly in the grammars of early 19th-century Japanese speakers, but then over time came to be dominated by a faithfulness constraint such as IDENT-IO[*COR*] (preserve coronal place of input segments). This reranking would have allowed the TI sequences in later loans to be

adapted as TI instead of ČI. However, this cannot then account for the different behavior of loans containing [t] vs. those containing [d], since both groups of loans violate *TI as formulated above. At the very least *TI needs to be split into two more specific constraints sensitive to the voicing of the stop, *TI (no /t/ before /i/) and *DI (no /d/ before /i/), which can then be ranked independently of each other with respect to IDENT-IO[*COR*]. Then the relative acceptability of [di] vs. [ti] in loans borrowed during the early 20th century can be derived using the ranking *TI » IDENT-IO[*COR*] » *DI, which would allow [di] to be adapted as [di], but force [ti] to be adapted as [tʃi] (Table 3).

	*TI	IDENTIO[<i>COR</i>]	*DI
'team' a. tiimu	*!		
b.  tʃiimu		*	
'dean' a.  diin			*
b. dʒiin		*!	

Table 3: Adaptation of 'team' as *tʃiimu* and 'dean' as *diiN*, with *TI » *DI

The distinction between these two constraints is not motivated by any native phonological processes, however, and would exist only to explain the loanword data. This is similar to Ito and Mester's postulation of the two constraints *TI (no coronal stops before /i/) and *SI (no coronal fricatives before /i/), instead of a single constraint banning all coronal segments before /i/, which would adequately account for the native distribution of coronals. Not only does this go against the goal of not postulating loanword-specific constraints in explaining adaptations, but to account for the more fine-grained phonological neighborhood effects in adaptations, there would need to be even more specific constraints, such as *#TI (no word-initial /t/ before /i/) or *DIN (no /d/ before the sequence /ɪŋ/), which are not only even less plausible than *TI and *DI, but also refer to non-native features of the input, such as whether the vowel is tense or lax, or whether the TI sequence occurs with the segment /ŋ/ (which is not a phoneme of Japanese).

Besides, it is not clear what would have motivated this reranking of *TI and *DI with respect to IDENTIO[*COR*] in the first place. As with the previously mentioned case of coda consonants, there were no other sound changes taking place in the native Japanese phonology during the 19th and early 20th centuries differentially affecting /t/ and /d/ which could have motivated the reranking. As McMahon (2000) points out, without a theory-internal explanation of constraint reranking, it ends up being nothing more than a description of the facts of the sound change in OT terms, and cannot be considered an explanation in itself as to why the sound change took place.

4. A perception-based account of coronal adaptation

The problems with the OT account sketched above indicate that markedness constraints alone cannot be used to account for adaptation patterns without having them refer to specific properties of the input, making them impossible to justify on the basis of the native phonology only. Perhaps, then, the differences in input are due to misperception of the source language forms. Researchers such as Iverson et al. (2003) and Peperkamp (2005) have argued that the input for loanword borrowings can be greatly affected by the language-specific perceptual habits of the speaker/listener doing the borrowing. For example, Japanese listeners are more likely than French listeners to perceive epenthetic vowels (which are not actually present in the input) breaking up consonant clusters, and this may be due to constraints on syllable structure in Japanese influencing Japanese listeners' perception of consonant sequences (Dupoux et al. 1999). This suggests that the differential acceptability of TI sequences among Japanese speakers may ultimately be due to the perceptibility of [t] and [d] before the vowels [i] and [ɪ] as coronals instead of palatals (and stops instead of affricates). Since [di, dɪ] became more commonly adapted as [di] before [ti, tɪ] was adapted as [ti], it was perhaps less likely to have been misperceived by late 19th and early 20th century Japanese speakers as [dʒi], while [ti, tɪ] seems to have been more likely to be misperceived as [tʃi].

There may be a perceptual explanation for the different behavior of coronal stops and fricatives before /i/ in loanwords as well. While /t+i/ sequences are realized as [tʃi] in native Japanese words, resulting in a change in manner of articulation (from stop to

affricate), /s+i/ sequences are realized as [ʃi], preserving the fricative nature of the underlying segment, for example in /das+imasu/ → [daʃimasu], the polite form of the verb /das+u/ → [dasu] 'to take out; to get out'. The perceptual cues distinguishing [ti] from [tʃi] would thus be more salient than the cues distinguishing [si] from [ʃi], since [s] and [ʃ] are both fricatives, but [t] and [tʃ] differ in their manner of articulation (in particular, there would be a burst of friction noise in the production of [tʃi] which would not be present in [ti]). Thus a Japanese listener may not have as much difficulty in distinguishing [ti] from [tʃi] in English as they would have in distinguishing [si] from [ʃi], and thus would be more likely to preserve [ti] in loanwords. This is arguably a more elegant explanation for the different nativization patterns of coronal stops and fricatives than the stipulation of two different markedness constraints to explain the unacceptability of forms like **sitʃi* 'city' (vs. the attested form *fiti*).

Variation in adaptation patterns can also be accounted for under a perceptually-based approach, if we assume that these perceptual biases are statistical generalizations only, and are not categorical processes. In other words, the same listener may perceive a particular production of [ti] as either [tʃi] or [ti], depending on the speaker's articulation, the amount of ambient noise in the environment, and other performance factors.

However, it is not immediately clear under this account why there would be a difference in adaptation patterns due to the voicing of the stop (which would imply that Japanese listeners are more likely to perceive [ti, tɪ] as [tʃi] than [di, dɪ] as [dʒi]). The most obvious reason would be that English [t] is often aspirated, depending on the phonological environment it occurs in, while [d] is unaspirated, and Japanese listeners tend to perceive the aspiration noise after [t] as friction noise, which would result in the misinterpretation of the [t] as a token of [tʃ] instead. This would predict that unaspirated [t], for example the [t] in an [st] cluster, would then be more likely to be adapted as [ti] instead of [tʃi] in earlier loanwords, but this does not seem to be the case, given loans like *sutʃiiru* 'steel', dating from 1864, *insutʃiŋkuto* 'instinct', from 1880, and *sutʃiimu* 'steam', from 1898 (Arakawa 1977). While there are also many cases of [st] being adapted as TI, such as *misutikkū* 'mystic', these all turn out to contain the sequence /-tɪk(s)/, which as we saw before tended to be adapted as TI fairly early on, starting around the turn of the 20th

century, so it is unclear whether it is the lack of aspiration or the presence of /-ɪk(s)/ (or both) which causes the TI sequences in these words to be adapted as TI.

Finally, even if there turn out to be perceptual reasons for the dependence of coronal adaptation patterns on lexical neighborhood and other specific features of the input which do not play any role in the native phonological generalizations governing coronal stops in Japanese, a perception-based account ultimately is no better than a markedness-based account in explaining the change over time in acceptability of these non-native patterns. If the differences in the perceived input among different speakers were the only factor determining whether a TI sequence would be adapted as either ČI or TI, then we would expect the relative proportions of ČI vs. TI adaptations in new loanwords to remain constant over time. But in fact TI sequences in words first attested before 1890 are usually adapted as ČI, while TI sequences in words first attested after 1930 are usually adapted as TI, and it is hard to see how there could be a perceptual reason for this difference, since there is no reason to believe that mid 19th-century English speakers produced coronal stops before /i/ and /ɪ/ substantially differently from mid 20th-century English speakers.

5. The role of loanword diffusion in changing adaptation patterns

The failing of both the markedness and perception-based approaches in explaining loanword adaptation is that neither approach can explain how the preferred adaptation strategy in a speech community can change over time. This is because both approaches focus solely on the role of the individual speaker in generating a particular adaptation, and do not consider how the conventions for adapting loanwords are eventually established among the members of a speech community. While knowledge of these conventions depends on knowledge of how individual loans are adapted, and thus would also depend on knowledge of the loans themselves outside of the bilingual speakers who originally borrowed them, most generative work on loanword phonology does not consider what role, if any, the transmission of loanwords from the initial borrowers to other members of the speech community may have in determining the final established form of the loanword. Instead, these researchers, if they consider this issue at all, seem to

be assuming that the established loanword will remain unchanged after its initial adaptation. Paradis and LaCharité (1997) is an exception, but even they seem to put more emphasis on the role of individual (bilingual) borrowers' adaptations than on the subsequent diffusion of loans in explaining loanword adaptations: "Sociolinguistic studies show that the role of monolinguals in loanword phonology is *limited* to using and transmitting established loans, and, phrased in our terms, adapting⁶ the peripheral segments, which may sometimes have been left unadapted by bilinguals." (p. 394, my emphasis)

However, the main sociolinguistic study that Paradis and LaCharité (1997) cite, Poplack et al. (1988)'s investigation of borrowing in Francophone neighborhoods in the Ottawa-Hull area, can be interpreted as providing evidence for the importance of the diffusion process as well. While bilingual speakers produced many more loanword tokens than monolinguals in their study, the tokens produced by bilinguals tend to show less nativization than those produced by monolinguals. Also, there is a (possibly nonlinear) correlation between the number of speakers attested using a loanword and the degree of nativization, with those words being used by an intermediate number of speakers (less than about 20 speakers, based on their data) showing a degree of nativization falling in between nonce borrowings used only by a single speaker and established borrowings widely used throughout the speech community. The degree of nativization of a loanword also correlates to the length of time it has been attested, with tokens of words that have been attested since the 19th century showing more nativization than those words that have only been attested recently. These two correlations suggest that, as a loanword becomes more widespread through a speech community over time and is being transmitted among more and more monolingual speakers, these speakers are performing additional phonological changes to the original form of the loanword as it was introduced by bilingual speakers. While Poplack et al. focus mostly on segmental adaptations of loanwords, they also consider stress assignment as well, which suggests that higher-level

⁶ Paradis and LaCharité (1997) use "adaptation" in a slightly different sense than I do in this paper; while I have been using it to refer to the mapping from L2 sounds to L1 sounds, they use it to refer to what I am calling "nativization", that is, changing the loanword so that it has fewer violations of native phonological constraints.

phonological structures can also become more nativized over time in the process of loanword transmission.⁷

We can see how this trend for the nativization of loanwords over time emerges from the individual interactions between speakers involved in spreading a particular loanword if we consider what happens as a loanword containing a TI sequence, such as *tiimu* 'team', is repeated among a group of Japanese speakers, some of whom are bilingual in Japanese and English, and the rest of whom are monolingual and thus are biased towards perceiving TI as ČI instead of TI. If the number of monolinguals is relatively large compared to the number of bilinguals, and the monolinguals tend to have little contact with bilinguals, then most of the monolinguals in the speech community will have only indirect exposure, through one or more monolingual intermediaries, to the original form *tiimu* of the loanword as it was produced by a bilingual. As the number of these intermediaries increases, it becomes more and more likely that at least some of them will have misperceived other speakers' productions of *tiimu* as *třimu*, and will end up adding the form *třimu* instead of *tiimu* to their own lexicons, and thus will produce subsequent tokens of the loanword in their own speech as *třimu* instead of *tiimu*.⁸ Since there is no corresponding pressure to misperceive ČI as TI, we can expect that as the loanword spreads through this group of speakers, the *třimu* tokens will end up outnumbering the *tiimu* tokens over time, and the established form of the loanword will end up being *třimu*, even though it was originally borrowed as *tiimu*. In a sense, then, TI sequences end up being more marked than ČI sequences among this group of speakers, but this is not necessarily due to a specific markedness constraint existing in the phonological competences of each of the individual speakers, but rather results from the interaction

⁷ To be fair to Paradis and LaCharité, their research focuses mainly on loanword nativization at the segmental level, and not on higher-level phonotactic sequences such as TI. Since monolingual speakers tend to be much less tolerant of non-native segments than of non-native phonotactics (consider the difficulty most English speakers have in producing words like *Bach* with a velar fricative, compared with the onset clusters that occur in loans such as *knish* or *schlepp*), it follows that bilinguals would be more likely to nativize non-native segments than non-native phonotactic sequences, thus reducing the role of monolingual transmission in determining adaptations at the segmental level.

⁸ There may be an effect of articulatory strategies as well, since bilinguals will have many more opportunities than monolinguals to produce TI sequences while speaking L2, and hence will have the necessary motor movements more firmly entrained than monolinguals would have.

between the perceptual biases of the speakers (creating a pressure to misperceive TI as ČI, but with no corresponding pressure to "correct" the misperceived ČI as TI) and the structure of the social network in which these speakers are embedded (making it unlikely for most of the speakers to have direct perceptual access to the original form of the loanword).⁹

The question now is, given this model of loanword nativization as an emergent process arising from the diffusion of loanwords throughout a highly monolingual speech community, how can the markedness of TI then change over time, so that TI becomes more and more acceptable? There are at least two possible causes for this change: a change in the strength of the pressure in the speech community to misperceive (and/or misproduce) TI, or a change in the structure of the speech community itself (in particular, the level of access to speakers of L2 in the L1 speech community). For example, if the relative proportion of bilinguals in the speech community were to increase, then monolinguals would be more likely to be in contact with bilinguals and would have more opportunities to be directly exposed to less-nativized tokens of loanwords (instead of being indirectly exposed through a chain of monolingual intermediaries), decreasing the likelihood of a misperception taking place and resulting in less overall nativization. It has often been noted in the literature on lexical borrowing that as a speech community becomes more bilingual over time, the likelihood that non-native patterns in new loanwords will be left unnativized also increases (Haugen 1950, Thomason and Kaufman 1988). This is confirmed by Poplack et al. (1988), who find that speakers living in Ottawa communities (on the Ontario side of the border, and having a larger number of Anglophone speakers), are less likely to nativize loanwords from English than those speakers living near Hull (on the Québec side of the border, with fewer Anglophones present).

⁹ Hale and Reiss (2000) make a similar argument that markedness is epiphenomenal and not a property of a speaker's phonological competence as such, since markedness effects can be derived from the effects of perceptual salience during language acquisition. Also, Hare and Elman (1995) and Kirby and Hurford (2001) present connectionist models of language change which, while not modeling the social structure of a speech community in any great detail, do consider the cumulative effects over time of transmission errors between individual speakers.

While the dictionary data collected from Arakawa (1977) does not have detailed information on the bilingual ability or other sociolinguistic properties of the individual Japanese speakers who produced each of the attested loanword tokens, it is possible to infer from the dependence of the adaptation patterns used for a particular loanword on its date of first attestation that an increase in contact with English speakers among late 19th-century Japanese speakers is what originally triggered the change in the acceptability of TI. Recall that the number of loanwords with the TI → TI adaptation pattern started to increase in the period 1870-1890 (Figure 1), with TI → TI becoming as common as TI → ČI from 1890-1910. These two time periods correspond with the reign of the Meiji emperor, during which many experts and consultants from Western nations were being brought into Japan by the Japanese government to help with the modernization of the country. Also, native Japanese professors of the early Meiji period often lectured in English, as well as other European languages like French or German, although they switched back to Japanese by the end of the 19th century (Loveday 1996, pp. 66-68). Mandatory education in English also began at this time with the establishment of the public educational system (p. 66), although this declined somewhat during the first part of the 20th century (pp. 73, 75). At any rate, late 19th and early 20th century Japanese speakers would have had many more opportunities to interact with speakers of English and be exposed (directly or indirectly) to borrowings from English than would Japanese speakers in the early to mid 19th-century, who generally had little contact with the outside world.¹⁰

However, an increase in bilingual contact among Japanese speakers can only explain the general trend over time for less nativization of new loanwords, and cannot by itself account for the more fine-grained effects of voicing and phonological neighborhood that are seen in the patterns of adaptations of TI. There also seems to have been a change in the pressure to perceive TI as ČI among Japanese speaker/listeners as well, with the likelihood of TI being perceived as ČI depending on the phonological environment a

¹⁰ Note that the actual level of bilingual ability in English among Japanese speakers has always remained relatively low, due to the style of English instruction common in Japan which emphasizes reading and writing skills over speaking and listening skills.

given TI sequence occurs in. In psycholinguistic models of the lexicon, such as the TRACE model (McClelland and Elman 1986) or exemplar-based models (Pierrehumbert 2001), lexical entries are organized on the basis of phonological and/or phonetic similarity, and the processing of a lexical entry can be influenced by other entries that are sufficiently similar to it. Thus the ability of an individual speaker to correctly perceive, and subsequently produce, the TI sequence in a word like *tiimu* would depend to some extent on the existence of other words similar to *tiimu* in her lexicon, and whether they have a corresponding TI or ČI. For example, if a speaker already knows many other words with word-initial TI, like *tii* 'tea' or *tiineedʒaa* 'teenager', then we can expect that she will be more likely to correctly perceive a token of *tiimu* as containing TI rather than ČI, and will be more likely to produce tokens of *tiimu* in her own speech using TI instead of ČI. On the other hand, if the speaker does not know any other words with initial TI, then the only words similar enough to *tiimu* to influence perception would be native words like *tʃiisai* 'small', all of which would have word-initial ČI since TI does not occur natively, and we would expect that this speaker would then be more likely to perceive *tiimu* as also containing word-initial ČI, instead of TI. This suggests that there should be an effect of type frequency on nativization, for monolingual speakers at least. Since monolinguals are more likely to be exposed to TI occurring in phonological environments with a high type frequency as these loanwords spread through the speech community, these speakers will be more likely to add such words to their own lexicons, thus making it more likely for them to subsequently perceive TI sequences occurring in the same environment in other loanwords as TI instead of ČI. Over time, then, the TI sequences in these loanwords should be less likely to be nativized than TI sequences occurring in less common phonological environments.¹¹ With bilingual speakers, it is less clear whether type frequency would have a similar effect on perception and production, since bilinguals

¹¹ It is unclear whether there would be an effect of token frequency as well, so that more frequent loanwords are less likely to be nativized than less frequent ones; this would depend on whether token frequency is directly represented in the lexicon or not, and what effect token frequency has on lexical processing. Arakawa (1977) does not give any data on the frequency in speech or in text of the loanwords listed in his dictionary, and given that the token frequency of a loanword does not necessarily correspond to the token frequency of the English source word, it would be difficult to estimate the token frequencies for the loanwords in this data set (unlike the type frequencies, which can be easily counted).

are also being influenced by their knowledge of the L2 phonology and lexicon, instead of relying solely on the L1 phonology and lexicon (as monolinguals do) in perceiving and producing a given loanword. But given that bilingualism in English has never been that common among Japanese speakers, we can expect that monolingual behavior will generally dominate during the nativization process, and thus that TI sequences occurring in more common phonological neighborhoods are more likely to be preserved as TI, while TI sequences in less common neighborhoods are more likely to be nativized over time to ČI. This prediction is borne out by the data in Table 4, which lists the most common phonological neighborhoods among loanwords with TI from Arakawa (1977) by their date of first attestation, showing that loans with /-ti#/ (*city*, *humanity*, ...) and /-tɪk(s)/ (*statistics*, *mystic*, ...) tend to be the most common in terms of type frequency among loans first attested from 1870-1930, followed by loans with /#d-/ (*dilemma*, *dinner*, ...) and /-diV/ (*stadium*, *radio*, ...).

1870-1889		1890-1909		1910-1929		1930-1949		1950-1969	
-ti#	14	-ti#	8	-tɪk(s)	8	-tɪk(s)	9	-tɪŋ#	16
-tɪk(s)	6	#d-	8	-ti#	5	#d-	7	#d-	14
#d-	6	-tɪk(s)	6			-diV	6	-diV	11
-diV	5	-diV	6					-ti#	9
-di#	5							-di#	6
								#dis-	6
								-dɪŋ#	5
all /ti/	40	all /ti/	28	all /ti/	23	all /ti/	30	all /ti/	53
all /di/	25	all /di/	23	all /di/	12	all /di/	24	all /di/	48

Table 4: Most common phonological neighborhoods among source words for loans, by date of first attestation of the corresponding loan from Arakawa (1977). Phonological neighborhoods with fewer than five examples for a given time period are not included.

Comparing the data in Table 2 to Figures 4 and 5, we can see that the TI sequences in the most common phonological neighborhoods came to be adapted as TI earlier than the TI sequences in other phonological neighborhoods. Recall that words with /-ti#/ were the earliest among TI-containing loanwords to be adapted as TI (Figure 4), with the word *city* being attested as *fiti* as early as 1845 (Arakawa 1977), while words with /-tɪk(s)/ and /#d-/ started to be adapted as TI from 1900-1930 (Figure 5), before most

other loanwords with TI.¹² The only anomalous patterns are word-final /-di#/ (*lady*, *caddy*, ...) and /- $\{t,d\}i\eta\#$ / (*batting*, *wedding*, ...), both of which are not all that frequent and yet are usually adapted as TI starting in 1870-1900, and /-diV/, which is about as common as /#d-/ and yet continues to be commonly adapted as ČI well into the 20th century, as shown by loans like *radziumu* 'radium', dating from 1904, and *radzio* 'radio', from 1926 (Arakawa 1977). There seem to be phonetic factors affecting different lexical neighborhoods as well; for example, the /-di#/ pattern is perceptually very similar to the /-ti#/ pattern, since the stop would generally be flapped in both cases in dialects of American English, while obstruents in word-initial position tend to be more perceptually salient than word-medial ones, which might explain the different behavior of /#d-/ and /-diV/. At any rate, there does seem to be a correlation between the type frequency of the phonological environment that a TI sequence occurs in and the likelihood that it will be nativized over time, with TI sequences occurring in more frequent phonological neighborhoods being less likely to be nativized to ČI.

6. Conclusion

We have seen that the adaptation patterns of TI sequences in Japanese loanwords show a complex, yet systematic, pattern of variation over time, depending on date of first attestation, voicing of the coronal stop, and phonological neighborhood. While these patterns are difficult to explain under approaches to loanword phonology which look only at the individual behavior of a single idealized speaker, they become explicable under an approach that considers the aggregate behavior of a group of interacting bilingual and monolingual speakers as a loanword spreads among them. In particular, the degree of nativization of a non-native pattern in a particular loanword is predicted to depend on both the level of access to bilingual models of loanword production among monolingual speakers during the time that the loanword is becoming established in the speech community, and on the type frequency of the lexical neighborhood that the non-native

¹² In fact, there are two interesting nonce adaptations attested in Arakawa (1977), *sadžisutikku* 'sadistic', dating from 1953, and *oputfimisutikku* 'optimistic', from 1963, which preserve the [t] in /-tɨk/ from the source word even though the other TI sequence in the word is nativized. These two loanwords are usually attested as *sadisutikku* and *oputfimisutifikku*, respectively.

pattern occurs in. Among TI-containing loanwords, those with TI occurring in low-frequency phonological neighborhoods are more likely to be nativized over time than those with TI occurring in high-frequency phonological neighborhoods. Also, nativization of loanwords is more likely when access to bilingual speakers in the overall speech community is low, and decreases over time as access to bilingual speakers increases. These two cross-cutting tendencies interact to form the varying adaptation patterns seen in TI-containing loanwords borrowed since the mid 19th century, and have ultimately resulted in a kind of contact-induced sound change, introducing a new contrast in Japanese between alveolar stops and palatal affricates before /i/ in recent loanwords.

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