Cet article s'attaque à l'hypothèse répandue que les adaptations d'emprunts résultent d'une mauvaise perception phonétique de la part des emprunteurs plutôt que d'une mise en correspondance de phonèmes. À partir de découvertes sur la perception phonétique interlangue, nous examinons trois corollaires découlant de cette hypothèse. Le premier est que les occlusives voisées de l'anglais devraient être dévoisées en espagnol; le deuxième, que la vibrante [ɹ] devrait produire [w] dans les emprunts anglais en japonais. Enfin, le troisième est que les consonnes des suites obstruant-sonantes en coda devraient être inversées dans les emprunts français en anglais. Aucune de ces prédicitions n'est confirmée dans notre base d'emprunts de 27 909 formes, laquelle révèle plutôt que les adaptations sont phonologiques.
ADDRESSING AND DISCONFIRMING SOME PREDICTIONS OF PHONETIC APPROXIMATION FOR LOANWORD ADAPTATION

Darlene LACHARITE
Carole PARADIS

1. Introduction

Loanword adaptation refers to the sound changes that borrowed words often undergo when they are used in another language. For instance, the French word *croissant* [kʁwaʁ] is usually pronounced either as [kʁəsɑ̃] or [kwaʁ] in English. In the literature there are two alternative explanations for loanword adaptation. The first attributes it mainly to faulty perception on the part of those who adapt loanwords (henceforth referred to as the borrowers). Borrowers may not

2. Different forms of a loanword often exist. We call each variant a loanword form and all variants pronounced by our consultants are taken into account in our analyses. To build a corpus of loanword forms, recent loanwords are gathered from a variety of sources and their pronunciations are checked with a minimum of three native speakers of the L1. We use oral elicitation techniques, and every loanword pronounced by each consultant constitutes a "form" whether or not it is a variant that has already been produced by another consultant. Loanwords whose pronunciations cannot be verified by at least one of our consultants are discarded.

3. We are interested in on-line adaptation, not simply the use of loanwords, so when we refer to borrowers, we mean those who actually introduce and adapt loanwords. Those who merely use borrowed words that have already become integrated into the native vocabulary might have no access to a borrowed item's L2 form, so there is no reason to assume that the phonological form is notably different from the surface form. For example, the vast majority of English speakers have no idea that *coupon* is borrowed from French and only those who speak French would know that, in French, the word has a nasal vowel. However, we assume that comparing the L1
accurately perceive foreign sounds and structures because they interpret the acoustic signal through the lens of a perceptual system that is attuned specifically and exclusively to L1, their native language. We refer to this as the phonetic approximation stance because, according to that position, loanword adaptation is based on L1-referenced perception of the surface, phonetic form of a foreign word.

Despite abundant sociolinguistic evidence that those who borrow and adapt loanwords are bilingual (Haugen 1950; Weinrich 1970; Grosjean 1982; Grosjean & Soares 1986; Poplack, Sankoff & Miller 1988; Adlar & Tagliamonte 1998; Samar & Meechan 1998; etc.), in phonological circles it is still widely assumed, and sometimes argued (e.g. Silverman 1992; Yip 1993), that loanword adaptation is a matter of phonetic approximation. Often this view is only implied, but some authors such as Silverman (1992), Yip (1993) and Kenstowicz (2001) adopt this position explicitly. For instance, in a study of the adaptation of English loanwords in Cantonese, Silverman (1992) proposes that all loanword adaptation is phonetic approximation. Despite acknowledging that “Many Cantonese speakers who employ English loanwords possess a good command of both spoken and written English...”, Silverman (1992: 296) goes on to say that

“...as they are speaking Cantonese during the process of loanword incorporation, it is this system which will determine how incoming forms are perceived...When confronted with a segment whose feature matrix in English does not exist in Cantonese, Cantonese speakers will represent and produce the native segment which most closely approximates the input in articulatory and/or acoustic properties.”

In sum, phonetic approximation supposes that, given the limiting factor of a perceptual system that is not attuned to the phonetics or phonology of L2, the language from which the

and L2 forms of relatively recent borrowings provides a snapshot of the adaptation process.
loanword is taken, the borrower’s efforts often fall short of correct perception of L2 sounds and structures. This limitation is held responsible for many, if not all, the sound changes seen in loanword adaptation.

The second view – for which we have argued in several articles, most notably LaCharité & Paradis (2000) and Paradis & LaCharité (2001) – is that loanword adaptation is phonological. Under this view the borrower operates on the mental representation of an L2 sound or structure, not directly on its surface form. Adaptation in this view presupposes that borrowers identify foreign sounds and structures accurately, in relation to the phonology of L2. However, these foreign sounds and structures have to be made to conform to the phonological requirements of L1. This is why borrowers adapt them and why they do so more extensively when communicating with monolingual L1 speakers.

Proponents of phonetic approximation have, to our knowledge, made little effort to examine loanword adaptations in the light of empirical research into cross-linguistic sound perception (or production). However, studies of cross-linguistic perception make very specific predictions that should be tested against loanword data. That is to say, if loanword adaptation is due to phonetic approximation / faulty perception, then we should see the same patterns in loanwords that are seen in the sound confusions revealed by cross-linguistic perception studies. Paradis & LaCharité (1997) and Jacobs & Gussenhoven (2000) have already provided a criticism of Silverman (1992), Yip (1993) and phonetic approximation as a general loanword adaptation strategy. The purpose of this article is to augment previous arguments by considering three specific findings vis à vis cross-linguistic perception of speech sound and their predictions for loanword adaptation, and then test these predictions against the Project CoPho loanword databases.4

4. Project CoPho is under the direction of Carole Paradis and Darlene LaCharité. Its databases currently include 11,238 loanwords (27,909 loanword forms). The corpora include French loanwords in Moroccan Arabic, Kinyarwanda, Lingala, Fula and Canadian English, and of English loanwords in Quebec City French, Montreal French, Parisian French, Mexican Spanish and Calabrese Italian. To our
Comparing the predictions against the actual realizations of loanwords reveals that the perception performance of monolingual speakers is not paralleled in the treatment of loanwords. In all three cases that we examine here the predictions of the phonetic approximation stance are disconfirmed. We interpret this as indicating that loanword adaptation is not based on the L1-guided perception of the surface phonetic form of L2 sounds and structures, but rather on accurate perception and interpretation of their L2 phonological structures.

2. Phoneme mismatches

As pointed out by Pierrehumbert (2000), there is a large body of data contradicting the idea of a uniform cross-linguistic phonetics-phonology interface. In fact, this can be stated in even stronger terms: “...there is no known case of two corresponding phonemes in two languages having fully comparable denotations” (Pierrehumbert et al. 2000: 286). Otherwise put, the precise phonetic realization of a given phoneme is different from language to language. For example, both English and French have the phoneme /u/ in their respective segment inventories but, at a phonetic level, the two languages realize this phoneme quite differently. Among other differences, the /u/ of English is generally realized as an apical alveolar, while that of French is realized as an apicolaminal dental (see Dart 1998 for a detailed articulatory comparison of French and English coronal consonants). As another example, both French and English have the phoneme /i/, but in English, /i/ is produced with a higher first formant frequency (F1) and a lower second formant frequency (F2) than in French. The phonetic realization of English /i/ is also significantly longer in duration and somewhat diphthongized (MacKay 1987: 75).

The present importance of language-specific phonetic variation is that the phonetic attributes associated with a given phonological category in one language may be associated with a knowledge, this is the largest loanword database that has been studied from the point of view of phonology (see Paradis & Prunet 2000 and Paradis & LaCharité 2001 for details).
different phoneme or phoneme class in another language. For example, on the basis of its phonetic attributes, American English [i] is considered by adult Swedes to be a poor exemplar of Swedish /e/, rather than of Swedish /i/ (Kuhl & Iverson 1995). If perception at the surface level is held responsible for loanword adaptation, then we should see numerous cases where an L2 phoneme identified with the “wrong” phoneme in L1. That is, we should see phoneme mismatches. To use the results of the Swedish study as an example, in words borrowed from American English into Swedish, one expects English /i/ to often be adapted as Swedish /e/. We do not test this particular prediction in the present article but it should, along with other relevant hypotheses of its kind, be tested by proponents of the phonetic approximation stance.

In the following subsections, we test two other predicted cases of phoneme mismatches against the Project CoPho loanword databases. These include the adaptation of voiced stops in English loanwords in Spanish and the adaptation of the rhotic in English loanwords in Japanese. We consider each of these cases in turn.

2.1 The adaptation of English voiced stops in Spanish

Voice Onset Time (VOT) differences are used to distinguish voiced from voiceless stops across languages, but the precise implementation of VOT is language-specific (Ryalls 1996; Benki 1998: 16, among many others). In Spanish, as in (European) French, voiced stops are normally characterized by a negative VOT, which means that vocal fold vibration begins before the release of the plosive. In the production of Spanish (and French) voiceless plosives, vocal fold vibration begins within 30 milliseconds of release, often immediately on release. English, in contrast, implements the voiced – voiceless stop distinction quite differently, phonetically speaking: For English stops classified as voiced, vocal fold vibration begins within 0-30 milliseconds of release, clustering between 0-25 milliseconds, while those classified as voiceless are characterized by a VOT generally in excess of 50 milliseconds (Ryalls 1996: 51). Thus, what English classifies as voiced stops are, from the Spanish phonetic point of view, voiceless.
Not surprisingly, Spanish speakers who are beginning to learn English are noted to confuse English voiced and voiceless stops, as shown by several cross-cultural production studies (Jameson 1967; Stockwell & Bowen 1970; Kelly 2000). And this is not just a pronunciation problem.

Several cross-cultural perception studies show that monolingual Spanish and English speakers classify onset stops as voiced or voiceless according to the VOT norms of their respective native language (e.g. Williams 1977; Flege & Eefting 1986; Strange 1995). In other words, listeners hear the same onset stimulus as voiced or voiceless, depending on whether they are native speakers of English or Spanish. However, increased exposure to English changes the listener’s perception of the voicing distinction. As Spanish speakers gain more experience with English, the point at which they identify a stimulus as voiced rather than voiceless changes, approaching the cross-over point for anglophones (Williams 1979; Flege & Eefting 1987). In brief, monolingual Spanish speakers classify English stops on phonetic grounds, leading to their (mis)identification as voiceless, in accordance with the VOT values of Spanish. However, as English proficiency improves, the VOT value boundary approaches that of English monolinguals, with the classification performance of Spanish-English bilinguals being comparable to that of English monolinguals.

If loanword adaptation is effected on the basis of faulty perception (i.e. according to Spanish VOT norms), in keeping with the phonetic approximation stance, then we expect English voiced onset stops to be adapted as voiceless. This prediction is tested against a corpus comprising 1,514 English loanword forms in Mexican Spanish (MS-1) which is appended to Fecteau (1998). The Spanish loan forms include a total of 563 English voiced stops (/b/, /d/, /g/) in onset position.

5. We assembled a second corpus of English loans in Mexican Spanish, that we refer to as MS-2 and which is appended to Bolduc (2001). The research made to test this hypothesis in MS-2 is ongoing but the statistics are not available yet. Nonetheless, we do not anticipate much difference between the two corpora since they basically contain the same loans, and the forms produced by the consultants of MS-2 seem very similar to those of MS-1 with respect to voiced stops.
Perceptual tests usually focus on onset position, because that yields purer perception results.  

As can be seen in (1), none of the English onset voiced stops undergo devoicing in MS-1.

(1) Voiced onset stops in English loans in MS-1

<table>
<thead>
<tr>
<th></th>
<th>/l/</th>
<th>/d/</th>
<th>/g/</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>cases</td>
<td>290</td>
<td>157</td>
<td>116</td>
<td>563</td>
</tr>
<tr>
<td>devoicing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>same phoneme</td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>deletions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The English voiced onset stops remain as is, i.e. voiced and undeleted, in all cases. Some examples of the treatment of English voiced stops as voiced stops are displayed in (2).

---

6. As Brownman (1980:224) states, “The strength of the acoustic signal varies in relation to syllable structure and word structure: there is more information syllable-finally and word-finally.” The pre-vocalic (onset) position is perceptually less salient than the post-vocalic (coda) position for a couple of reasons. First, the vowel carries more phonetic information about the place, manner and voicing of a following consonant than a preceding one (ibid:224). Second, in real word stimuli, lexical effects can confound perception (MacKay 1987: 288). The speaker of a language perceives the sounds in words somewhat conditionally, with lexical information often overruling acoustic information. In effect, as soon as the target word is identified (which can happen before the word is fully pronounced), the speaker may decide what will be heard even before it is heard. This can skew the perception results for those familiar with the language (native speakers and bilinguals), but not for those unfamiliar with the language who have little or no access to lexical information. Therefore, tests of consonant perception which aim at distinguishing the acoustic/perceptual correlates of one language group versus those of another are often considered to be more reliable when the consonant occurs in initial position (with nonsense or unknown words or syllables).
(2) Unchanged voiced stops in English loans in MS-1

<table>
<thead>
<tr>
<th>English</th>
<th>Engl. IPA</th>
<th>Spanish IPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>body</td>
<td>[bodi]</td>
<td>[bodi]</td>
</tr>
<tr>
<td>garbage</td>
<td>[gaɾbiʃ]</td>
<td>[gaɾbiʃ]</td>
</tr>
</tbody>
</table>

Stop devoicing occurs in coda position, but it is infrequent (9/126, i.e. 7.1%). We can thus conclude that, in spite of the fact that they are phonetically different from their respective Spanish counterparts, the English voiced stops are adapted in MS-1 according to their phonological (phonemic) status, not on the basis of their phonetics. In other words, the phonetic approximation stance would make a false prediction here.

2.2 The adaptation of the English rhotic in Japanese

If loanword adaptation is based on faulty perception, then another predicted case of a phoneme mismatch involves the adaptation of the English rhotic in English loanwords in Japanese. Both English and Japanese have a single rhotic phoneme in their respective segment inventories, but the phoneme is phonetically very different in the two languages. The English rhotic is a palato-alveolar central approximant, [ɹ], while the Japanese rhotic is realized as an alveolar tap, [ɾ]. Thus, the two sounds differ phonetically in place and manner, both important perceptual dimensions. In perceptual terms, English [ɹ] is much closer to the realization of Japanese /w/ than to that of Japanese /r/ (Mochizuki 1981; Yamada & Tohkura 1991). The perceptual closeness of [ɹ] to [w] might not come as a surprise to English speakers, given that young anglophone children usually confuse the two sounds, typically producing forms as *[kwai] ‘cry’ and *[vewi] before they master the adult-like pronunciations [kwaɪ] and [veɪi] (MacKay 1987: 193).

On the basis of the perceptual similarity between English [ɹ] and Japanese [w], Best & Strange (1992) predicted that American English [ɹ] would be identified by Japanese speakers as a poor example of the Japanese /w/ phoneme, rather than as a rhotic. This prediction was tested with two groups of Japanese speakers, one of which had very little experience with
spoken English (i.e. Japanese monolinguals), the other of which had much more experience with spoken English (i.e. Japanese-English bilinguals). The inexperienced group consisted of five adults who had been in the United States for less than seven months and who had had little or no (0-3 hours per week) conversation instruction. The experienced group included four adults who had been in the United States between 18 and 48 months and who had undergone eight to ten hours per week of conversation instruction with native English speakers.

Subjects were required to identify and to discriminate stimuli such as /wak/ and /bak/. In all the stimuli, [i] occurred in syllable onset position. As predicted, Japanese monolinguals were significantly more likely to perceive English onset [i] as an example of /w/. In contrast, Japanese-English bilinguals performed much more like (though not identical to) the American English controls. That is, they were significantly more likely than Japanese monolinguals to classify English [i] as a rhotic, rather than as /w/. In sum, those Japanese speakers with little or no exposure to spoken English classified the English rhotic in onsets on phonetic grounds, while those with more experience classified it on phonological grounds. Under the phonetic approximation view of loanword adaptation, we therefore expect to find a high rate of adaptation of English onset /r/ to Japanese /w/ in English loanwords in Japanese.

We tested this hypothesis against Goulet’s (2001) corpus of 2,991 English loan forms in Japanese. The Japanese loan forms include a total of 1,376 pertinent cases of English /r/. As can be seen in (3), English /r/ is never interpreted as /w/ in our corpus.

(3) Treatment of English /r/ in Japanese

<table>
<thead>
<tr>
<th></th>
<th>onset</th>
<th>coda</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>cases:</td>
<td>646</td>
<td>730</td>
<td>1,376</td>
</tr>
<tr>
<td>same phoneme</td>
<td>646</td>
<td>16</td>
<td>662</td>
</tr>
<tr>
<td>([i] → [r]):</td>
<td>(100%)</td>
<td>(2.2%)</td>
<td>(48.1%)</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>712</td>
<td>712</td>
</tr>
<tr>
<td>(a → a, V₁ → V₂)</td>
<td></td>
<td>(97.5%)</td>
<td>(51.7%)</td>
</tr>
<tr>
<td>deletions</td>
<td>0</td>
<td>2</td>
<td>2 (0.2%)</td>
</tr>
<tr>
<td>phonetic approximation</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

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English /t/ remains as is, i.e. as a rhotic phoneme, in all of the cases in onset position. Examples are presented in (4).

<table>
<thead>
<tr>
<th>(4)</th>
<th>English</th>
<th>Engl. IPA</th>
<th>Japanese IPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>cherry</td>
<td>[tʃeiti]</td>
<td>[tʃeri]</td>
</tr>
<tr>
<td>b.</td>
<td>rock</td>
<td>[rak]</td>
<td>[rokkur]</td>
</tr>
</tbody>
</table>

For the sake of thoroughness, we further considered the treatment of English onset labiovelar glides in English loanwords in Japanese, wondering whether the labiovelar glide might not sometimes be confused with the English rhotic. In other words, perhaps Japanese speakers, being unable to distinguish English [w] from [j], sometimes mistake the labiovelar glide for the English rhotic. If Japanese borrowers are unable to hear the difference, but are aware that there is one, they might even be expected to choose one or the other randomly. However, this never occurs; in 137/137 cases (100%), the English onset labiovelar glide is interpreted as a labiovelar glide, never as a rhotic. As with the stop voicing case, the equation of English [j] with Japanese /t/ and of English [w] with Japanese /w/ in loanwords runs counter to the predictions of the phonetic approximation view.

In coda position, as shown in (3), English /t/, does not surface as a rhotic. Typically, Japanese does not allow codas other than the famous /n/ or the first part of a geminate consonant (e.g. [rokkur] in (4b)). An English coda is thus normally adapted through resyllabification and vowel epenthesis as in (4b). English /t/ is unique among consonants in that it rarely becomes the onset of a new syllable (this happens in only 2.2% of the cases). The sonorant /r/, which is a particularly vowel-like consonant, is either incorporated into the preceding nucleus, most often yielding /ə/., as shown in (5a), or it surfaces as an epenthetic nucleus as in (5b), yielding /a/ here too.

<table>
<thead>
<tr>
<th>(5)</th>
<th>English</th>
<th>English IPA</th>
<th>Japanese IPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>bar</td>
<td>[bɔɾ]</td>
<td>[baɾ]</td>
</tr>
<tr>
<td></td>
<td>cooler</td>
<td>[kuɾəɾ]</td>
<td>[kuɾaɾ]</td>
</tr>
<tr>
<td></td>
<td>corner</td>
<td>[kɔɾnəɾ]</td>
<td>[kɔɾnaɾ]</td>
</tr>
</tbody>
</table>
b. store [stɔː] → [sutoa]
care [keə] → [kea]
volunteer [valɔntɪə] → [borantia]

However before coming to a firm conclusion about what is happening to coda /t/ in English loanwords in Japanese, more extensive research on the phonological representation of rhotics and the status of rhotacized vowels in English has to be conducted, which is well beyond the limits of this article.

3. Perceptual metathesis

Another misperception-based adaptation predicted by phonetic approximation is perceptual metathesis. This is what we call the process by which sounds in clusters are perceived in a different order than they occur chronologically because their actual order of presentation is not permitted in the language.

In dichotic listening tests, where one word of a minimal pair is presented to the right ear and another to the left, subjects merge the two words, hearing them as one. Even when the words are presented not quite simultaneously, monolingual subjects hear the two words as one, perceiving their merged sounds in a phonologically acceptable order, not necessarily in the order of presentation. For instance, when /lab/ is presented to one ear and /bɑb/ to the other, anglophone subjects hear /blɑb/, not */bɑb/ because the former is an acceptable onset cluster of English while the latter is not. Interestingly, /blɑb/ is perceived even when /lɑb/ is presented 100 milliseconds earlier (Day 1968; 1970, as reported in Cena 1978). If perception were directly based on the acoustic signal, then /l/ should be heard before /b/.

If loanword adaptation is based on L1-guided perception, as claimed by proponents of phonetic approximation, then we should find cases where clusters permitted in one language are misperceived as being differently ordered in a language which does not permit such clusters. French loanwords in English permit us to test this prediction. French allows coda clusters in which an obstruent is followed by a sonorant, as shown by the examples in (6).
(6) Some obstructent-sonorant coda clusters of French

\[ \begin{align*}
\text{[tk]} & \quad \text{maître; battre} \\
\text{[bl]} & \quad \text{table; câble} \\
\text{[kl]} & \quad \text{bicycle; débâcle} \\
\text{[sm]} & \quad \text{anarchisme; racisme} \\
\text{[vr]} & \quad \text{chèvre; livre}
\end{align*} \]

English, on the other hand, does not allow an obstructent to be followed by a sonorant consonant in the coda, though clusters in which those same segments are in the contrary order are frequent in English.

(7) Similar sonorant-obstructent coda clusters of English

\[ \begin{align*}
\text{[st]} & \quad \text{short; heart} \\
\text{[lb]} & \quad \text{bulb; alb} \\
\text{[lk]} & \quad \text{elk; bulk} \\
\text{[mz]} & \quad \text{aims; gums (with voicing assimilation)} \\
\text{[iv]} & \quad \text{nerve; carve}
\end{align*} \]

Phonetic approximation predicts that French coda clusters such as those seen in (6) will be perceived by anglophones in the reverse order, in accordance with English constraints. In particular, phonetic approximation predicts the following metatheses in French loanwords in English.

(8) Predicted adaptations in English

<table>
<thead>
<tr>
<th>Fr.</th>
<th>Predicted Eng. adaptations</th>
</tr>
</thead>
<tbody>
<tr>
<td>[tk]</td>
<td>[st] e.g. *[kələmərt] (kilomètre)</td>
</tr>
<tr>
<td>[bl]</td>
<td>[lb] e.g. *[təlb] (table)</td>
</tr>
<tr>
<td>[kl]</td>
<td>[lk] e.g. *[debalk] (débâcle)</td>
</tr>
<tr>
<td>[sm]</td>
<td>[mz] e.g. *[ʃovinizmz] (chauvinisme)</td>
</tr>
<tr>
<td>[vr]</td>
<td>[iv] e.g. *[ʃɔrviv] (chèvre)</td>
</tr>
</tbody>
</table>

If loanword adaptation is referenced to L1, instead of L2, as the phonetic approximation stance maintains, Lamoureux's (2000) corpus of 1,667 recent French loan forms in North American English is thus expected to display a significant number of inversions in consonant clusters. However, as can be seen in (9), this prediction is disconfirmed when tested against our corpus.
Inversion never occurs in the 81 obstruent-sonorant clusters of our French loans in English.

(9) Obstruent-sonorant clusters in French loans in English

<table>
<thead>
<tr>
<th></th>
<th>bl</th>
<th>br</th>
<th>kl</th>
<th>sm</th>
<th>tr</th>
<th>vr</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>French clusters</td>
<td>16</td>
<td>2</td>
<td>9</td>
<td>26</td>
<td>26</td>
<td>2</td>
<td>81</td>
</tr>
<tr>
<td>inversions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>insertions</td>
<td>13</td>
<td>1</td>
<td>8</td>
<td>26</td>
<td>23</td>
<td>2</td>
<td>73 (90.1%)</td>
</tr>
<tr>
<td>deletions</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5     (6.2%)</td>
</tr>
<tr>
<td>non-adaptations</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>3     (3.7%)</td>
</tr>
</tbody>
</table>

In French loans in English most such clusters (90.1%) are repaired through vowel epenthesis either within the cluster (the vast majority of cases), as in (10a), or at the end of the cluster, as in (10b).

(10) French | French IPA | English IPA

- a) ensemble → [œsambel] → [ansambel]
  filtre → [filta] → [fulta]
  sadisme → [sadism] → [sædzəm]
  débâcle → [debækl] → [døbækəl]
- b) chèvre → [ʃvər] → [ʃvεɾ]
  raison d'être → [rezɔdɛtʁ] → [retzandɛtʁ]

As in the phoneme mismatch cases, the prediction for loanword adaptation on the basis of L1-driven phonetic approximation is disconfirmed.

4. Conclusion

The purpose of this article was to lay out specific predictions of phonetic approximation for loanword adaptation and show that those predictions are disconfirmed when tested against our database of loanwords. More specifically, phonetic
approximation assumes that loanword adaptation is based on faulty perception of the surface form of sounds and structures in foreign words. It therefore predicts that the sound changes in loanwords will mirror the sound confusions found in cross-linguistic perception studies.

The first such prediction is that Spanish speakers will adapt English voiced onset stops as voiceless ones in English loanwords in Spanish. This prediction was disconfirmed: voiced onset stops are never devoiced in our corpus of English loans in Spanish. The second phonetically-driven prediction that we considered is that English [j] will be adapted in onset position as [w] in English loanwords in Japanese. This prediction was also disconfirmed when tested against our corpus of English loans in Japanese. Finally, the third phonetically-driven prediction that we addressed is that English speakers will reverse the order of the segments in obstruent-sonorant clusters in French loanwords in English. Here too the prediction of the phonetic approximation view was disconfirmed when tested against our corpus of recent French loans in North-American English. The idea that loanword adaptation is phonetic, i.e. due to the L1-referenced perception of foreign sounds and structures rather than being guided by L2 phonology, thus faces a serious lack of support from cross-linguistic perception findings.

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