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The influence of orthography on loanword adaptations

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Abstract

We investigate the influence of orthography on loanword adaptations by means of an experiment in which late French–English bilinguals produce on-line adaptations of English non-words. In half of the experiment, the stimuli are presented orally only, whereas in the other half, the oral stimuli are accompanied by their written representation. The adaptations of eight English vowels are shown to be different according to whether the input is oral or mixed (i.e. oral + written). In particular, the adaptations based on the mixed input more often reflect the way French speakers are used to read English graphemes. These results thus confirm the sensitivity of loanword adaptations to the presence versus absence of a written representation. We conclude that in order to control for orthography, loanword adaptations are best studied in an experimental framework.

Keywords: Loanword adaptations; Orthography; Phonology; Phonetics

1. Introduction

Most research on loanword adaptations is directed towards formulating phonological and/or phonetic principles that determine how loanwords are nativized. Loanword adaptations are thus considered a purely grammatical phenomenon, on a par with native alternations. However, many other factors are likely to influence if and how loanwords are adapted. For instance, speech communities differ with respect to the presence of bilingual speakers and their level of proficiency, as well as to the presence of native speakers of the source language. Likewise, the prestige of the source language may vary across different speech communities. These differences can all be sources of variation for the speed at which loanwords are nativized and the nature of the adaptations they undergo at various stages.

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In this paper, we concentrate on yet another factor that may influence the nature of loanword adaptations: orthography. There are two ways in which orthography can have an impact. First, some loanword adaptations are clearly 'reading' adaptations; that is, they are pronounced as if they were native words of the borrowing language. For instance, the French word *cul-de-sac* is adapted as [kʌldəsæk] in English, which is obviously not derived from the French pronunciation [kytsak]. Second, and more subtly, there may be a certain amount of standardization as to how graphemes of the source language are pronounced in the borrowing language. For instance, French school children learn to pronounce the English grapheme <u> in words like *but* as their native vowel /œ/, and the English grapheme <oo> in words like *book* as their native vowel /u/. As adults, French speakers are likely to base their adaptations of English words on these between-language grapheme-to-phoneme correspondence rules.

Orthography is rarely taken into account as a possible factor in loanword adaptations, and when it is, its influence is usually described as marginal at most (Lovins, 1975; Danesi, 1985; LaCharité and Paradis, 2000, 2005; Paradis and Prunet, 2000). For instance, LaCharité and Paradis (2000) examined corpora of English loanwords in four languages and of French loanwords in five other languages and found that overall, 3.7% of the adaptations are influenced by the orthography. However, it should be noted that they only considered orthography as a possible factor for those adaptations that cannot be explained by phonological principles. In this way, 'reading' adaptations are relatively well identified, but adaptations based on between-language grapheme-to-phoneme correspondence rules will often go unnoticed, since they typically resemble or are even undistinguishable from phonologically-based adaptations. For instance, the French adaptation of English *brunch* as [bʁœnʃ] can at first sight be attributed either to a phonological principle that maps English /ʌ/ onto French /œ/ or to the between-language grapheme-to-phoneme rule according to which French speakers pronounce English <u> as their native vowel /œ/.[1] In other words, LaCharité and Paradis's calculation only provides a lower bound on the influence of orthography.

A theory of the phonological and phonetic principles that are active in loanword adaptations can only be developed if the influence of orthography (and other meta- and socio-linguistic principles) is factored out. It is thus important to understand to what extent orthography influences loanword adaptations in the first place. In this paper, we report on an experiment in which late French–English bilinguals adapt American English non-words. We examine the influence of orthography on the adaptation of the vowels by varying the nature of the input: in half of the experiment, participants are presented with oral stimuli, while in the other half, the same stimuli are accompanied by their written form.

2. Experiment

2.1. Hypotheses and predictions

We concentrate on the adaptation of eight English monophtongs in French. Four of these, /i/, /u/, /ɛ/, and /ɔ/ (as in *beat*, *boot*, *bet* and *bought*, respectively), also exist in French; the remaining

[1] Only rarely do between-language grapheme-to-phoneme correspondence rules yield a result that is surprising from a phonological point of view. An example is the French adaptation of English *sweater* as [switœʁ] rather than [swɐtœʁ], which is undoubtedly due to the fact that French speakers have learned that in English the grapheme <ea> most often corresponds to the phoneme /i/.

Table 1
The French adaptation of eight English vowels in integrated loanwords

English vowel	French adaptation	Example	
/i/	/i/	[spitʃ]	'speech'
/u/	/u/	[pul]	'pool'
/ɛ/	/ɛ/	[pɛp]	'pep'
/ɔ/	/ɔ/	[pɔpkɔʁn]	'popcorn'
/ɪ/	/i/	[stik]	'stick'
/æ/	/a/	[badʒ]	'badge'
/ʌ/	/œ/	[lœntʃ]	'lunch'
/ʊ/	/u/	[fut]	'foot(ball)'

four, /ɪ/, /æ/, /ʌ/, and /ʊ/ (as in *bit*, *bat*, *but*, *put*, respectively), do not exist in French. Table 1 shows the French adaptations of these vowels in integrated loanwords, i.e. loanwords that most French speakers know and that can be found in French dictionaries such as Le Petit Robert.

We compare these adaptations to the ones made by late French–English bilinguals in an on-line adaptation experiment with CVC non-words. These non-words are produced by four speakers of American English (AE), and presented either in the absence or in the presence of their written form. We thus compare the adaptations in two conditions: an oral condition (oral input only) and a mixed condition (oral + written input). We suppose that the latter condition most closely resembles the situation in which English loanwords are naturally adapted in French. That is, bilingual French–English speakers typically have experience with both spoken and written English.[2] We use the same set of stimuli in the two conditions. This design guarantees that any differences observed in the adaptations with the two types of input will be due to the influence of orthography.

The eight AE vowels we use are represented by several graphemes in English. We choose the commonest ones to use in the written presentation of the non-words (see Table 2). Regarding the influence of orthography, recall that a distinction should be made between possible 'reading' adaptations and adaptations based on between-language grapheme-to-phoneme correspondence rules. In the former case, the graphemes are read as if they were French, hence according to the French spelling rules; in the latter case, they are produced according to the way French speakers have learned to pronounce English graphemes in CVC words. Table 2 shows for each of the English vowels under consideration the grapheme that we used in the mixed condition together with, firstly, the French vowel(s) that this grapheme represents most often and, secondly, the French vowel that French speakers generally produce when reading this grapheme in English CVC words. Note that the latter are exactly those that are found in integrated loanwords.

French speakers may be quite good at imitating English vowels. For the purposes of our experiment, however, we want them to adapt the AE vowels as French vowels. We therefore ask them to insert the non-words within French carrier sentences as if they were novel verbs, borrowed from English; in these carrier sentences, the verbs appear as past participles. For instance, on the basis of the non-word *fip* participants should produce *fippé*. Both the presence of the French carrier sentence and the addition of a suffix prevent participants from imitating the AE vowels. The morphological change, however, has consequences for the use of the low-mid

[2] Note that it is impossible to provide written input only, since most English vowel graphemes are ambiguous. For instance, the grapheme <ea> corresponds to three different vowels, as in *team*, *steak*, and *ready*.

Table 2
French reading and English-like reading of graphemes representing eight English vowels in CVC words

English vowel	Corresponding grapheme	French reading of grapheme	English-like reading of grapheme
/i/	<ea>	–[a]	/i/
/u/	<oo>	/ɔ,ɔɔ/[b]	/u/
/ɛ/	<e>	/ɛ/	/ɛ/
/ɔ/	<o>	/o,ɔ/	/ɔ/
/ɪ/	<i>	/i/	/i/
/æ/	<a>	/a,ɑ/	/a/
/ʌ/	<u>	/y/	/œ/
/ʊ/	<oo>	/ɔ,ɔɔ/	/u/

[a] French does not have a grapheme <ea>, nor does it have word-internal sequences of the graphemes <e> and <a> (unless the *e* has an acute accent, as in *préavis* 'notice'). The sequence *ea* is part of the grapheme <eau>, representing /o/. It also occurs preceded by <g>, as in *mangeable* 'edible', where <ge> is a grapheme representing /ʒ/.

[b] The French grapheme <oo>, as in *alcool* [alkɔl] 'alcohol', is extremely rare. Slightly more often *oo* occurs as a sequence of two vowels, as in *coopérer* [kɔɔpere] 'to cooperate'.

vowels /ɛ/, /ɔ/ and /œ/ in the adaptations. For most French speakers, in fact, these vowels are raised to /e/, /o/ and /ø/, respectively, in those verb forms in which the root vowel appears in an open syllable, as is the case for the past participle:

(1) a. (je) laisse [lɛs] '(I) let'
(j'ai) laissé [le.se] '(I've) let'

b. (je) brosse [bʁɔs] '(I) brush'
(j'ai) brossé [bʁo.se] '(I've) brushed'

c. (je) pleure [plœʁ] '(I) cry'
(j'ai) pleuré [plø.ʁe] '(I've) cried'

There is, however, a lot of dialectal and individual variation in the use and distribution of mid vowels. We therefore do not distinguish between low-mid and high-mid vowels in the possible French adaptations. Likewise, due to dialectal variation in the use of the vowels /a/ and /ɑ/, we do not distinguish between them. Table 3 shows our predictions for the adaptations of the AE vowels in the mixed condition, based on, firstly, a 'reading' strategy, and, secondly, a between-language

Table 3
Predicted adaptations for the AE phoneme-grapheme pairs following a 'reading' strategy and a between-language grapheme-to-phoneme strategy

AE vowel	'Reading' adaptation	Between-language grapheme-to-phoneme adaptation
/i/;<ea>	?	/i/
/u/;<oo>	/O/	/u/
/ɛ/;<e>	/E/	/E/
/ɔ/;<o>	/O/	/O/
/ɪ/;<i>	/i/	/i/
/æ/;<a>	/A/	/A/
/ʌ/;<u>	/y/	/∅/
/ʊ/;<oo>	/O/	/u/

grapheme-to-phoneme strategy. The following dummy symbols are used: /E/ for /e/ and /ɛ/, /O/ for /o/ and /ɔ/, /∅/ for /ø/ and /œ/, and /A/ for /a/ and /ɑ/.

We concentrate on the influence of between-language grapheme-to-phoneme correspondence rules. In order to minimize the possibility of 'reading' adaptations, we test native French speakers who are advanced learners of English. We predict that in the presence of an orthographic representation, participants will more often produce the between-language grapheme-to-phoneme adaptations than in its absence.

2.2. Methods

2.2.1. Material

Twenty-four CVC items of the forms /fVp/, /mVb/, and /pVd/ were constructed, where the vowel was represented by one of the following eight English monophtongs: /i,ɪ,ɛ,æ,ʌ,ɔ,ʊ,u/. Seventeen of the items are non-words in both English and French, seven are low-frequency words in English, and one is a word in French (Appendix A). All items were recorded by two male and two female native speakers of American English; one talker had a Mid-West accent, one a New York accent, one a New England accent, and one a Mid-West accent with South-Eastern influences. Two of the talkers did not have /ɔ/ in their dialect, but were trained to produce this vowel for the purposes of the experiment. We thus obtained 96 stimuli (8 vowels × 3 frames × 4 talkers)[3]; they were digitized at 16 kHz at 16 bits, digitally edited, and stored on a computer disk. Likewise, four CVC training items were constructed and recorded, one per talker. Moreover, six French frame sentences were saved as text files (Appendix B).

2.2.2. Procedure

Participants were reminded that French has a number of verbs borrowed from English, such as *faxer* 'to fax'. They were told that their task would be to borrow novel English verbs and insert them in French sentences that would be shown on the screen. These sentences were then to be produced at a normal speech rate.

All participants performed the task with two different types of input, oral and mixed. In the oral condition, an English non-word was presented orally and 150 ms later, a French carrier sentence appeared on the screen. In the mixed condition, the written non-word first appeared on the screen. The oral stimulus was then played after 700 ms, immediately followed by the appearance of the French carrier sentence below the non-word. In the mixed condition, participants were explicitly asked to pay attention to the written input.

All stimuli were presented once in the oral and once in the mixed condition. Half of the participants were tested in the oral condition first, while the other half started with the mixed condition. Four training trials were presented at the beginning of each part of the experiment. All stimuli were presented in a random order. The carrier sentences were randomized with the restriction that the same sentence could not be presented twice in a row. The French sentences produced by the participants were recorded using the MS DOS sound record function.

[3] A native speaker of American English, who had received phonetic training and who was not one of the talkers, listened to all the stimuli and transcribed the vowels. There were four tokens that she identified as having another vowel than the intended one. They all concerned an intended vowel /ɔ/ being perceived as /ɑ/. We eliminated these stimuli from the experiment; due to an experimental error, they were not replaced.

Table 4
Mean percentages of adaptations in the different French vowel categories for the eight AE vowels in the mixed and the oral conditions

AE input vowel	Condition	French response vowels						
		/i/	/u/	/E/	/O/	/A/	/∅/	/y/
/i/	Mixed	**99.7**	–	–	–	0.3	–	–
	Oral	**100.0**	–	–	–	–	–	–
/u/	Mixed	–	**95.1**	–	4.9	–	–	–
	Oral	–	**99.3**	–	0.3	0.3	–	–
/ɛ/	Mixed	0.7	–	**82.6**	0.3	0.7	15.6	–
	Oral	1.4	–	**76.4**	–	8.3	13.9	–
/ɔ/	Mixed	–	0.5	–	**99.0**	–	0.5	–
	Oral	–	0.5	–	**91.7**	5.2	2.6	–
/æ/	Mixed	–	–	–	0.3	**99.3**	0.3	–
	Oral	–	–	–	0.7	**98.6**	0.7	–
/ʌ/	Mixed	–	3.1	1.0	4.5	0.7	**67.7**	22.9
	Oral	–	2.1	0.3	54.5	10.8	**31.6**	0.7
/ɪ/	Mixed	**100.0**	–	–	–	–	–	–
	Oral	**95.1**	1.4	1.4	–	–	2.1	–
/ʊ/	Mixed	–	**93.8**	–	6.3	–	–	–
	Oral	–	**76.6**	–	12.9	–	9.4	1.0

2.2.3. Participants

Twelve late French–English bilinguals, aged from 18 to 23, participated in the experiment. All participants had started to learn English at the age of 12 years, and 11 of them were students in an English department at the time of testing. Nine participants had spent an academic year in an English-speaking country. The remaining participants had spent one, six, and 18 months, respectively, in an English-speaking country.

2.3. Results

The produced past participles were extracted from the recorded carrier sentences. Two native speakers of French who had received a phonetic training listened to them and categorized the root vowels, choosing from among the following categories: /i,u,E,O,A,∅,y/.[4] The intercoder reliability was 97.3%.

The mean percentages of adaptations in the different French vowel categories, separated by AE input vowel and condition, are shown in Table 4. In each row, the cell corresponding to the adaptation that is predicted by the between-language grapheme-to-phoneme strategy is in boldface type.

In order to analyze the effect of the presence versus absence of written input, we divided the adaptations into ‘expected’ and ‘unexpected’ ones with respect to the between-language

[4] The dummy symbols have the same values as in Table 3.

grapheme-to-phoneme strategy. That is, adaptations were considered as 'expected' when they corresponded to the way French native speakers normally read English graphemes (see Table 3). In other words, 'expected' adaptations are those belonging to the cells with boldface type in Table 4. The mean percentages of 'expected' adaptations were submitted to a mixed ANOVA with the within-participant factors Condition (oral vs. mixed) and Vowel (/i/ vs. /u/ vs. /ɛ/ vs. /ɔ/ vs. /æ/ vs. /ʌ/ vs. /ʊ/ vs. /ɪ/), and the between-participant factor Order (oral-mixed vs. mixed-oral). There was a significant effect of Condition ($F(1,10) = 80.7$, $p < .0001$), with the participants giving more 'expected' adaptations in the mixed condition than in the oral condition, and a significant effect of Vowel ($F(7,70) = 12.9$, $p < .0001$), with the vowels /ɛ/, /ʌ/, and /ʊ/ yielding less 'expected' adaptations than the other vowels. Moreover, the interaction between Condition and Vowel was significant ($F(7,70) = 10.7$, $p < .0001$). No other main effect or interaction reached significance. Given that the factor Order did not yield a main effect and did not interact with any of the other factors, we omit this factor from further analyses.

In order to understand the interaction between Condition and Vowel, we carried out a series of restricted analyses for the individual vowels. The mean percentages of 'expected' adaptations for each vowel were thus submitted to a series of one-way ANOVAs with the within-participant factor Condition. The effect of Condition was significant for three of the eight vowels: /ɔ/ ($F(1,10) = 6.6$, $p < .03$), /ʌ/ ($F(1,10) = 22.5$, $p < .002$), and /ʊ/ ($F(1,10) = 5.8$, $p < .004$), with participants producing always more 'expected' adaptations in the mixed condition than in the oral condition.

2.4. Discussion

The present results show that the adaptations in the mixed condition follow the between-language grapheme-to-phoneme strategy more often than the adaptations in the oral condition. These results thus confirm the sensitivity of on-line adaptations to the presence versus absence of a written representation. Although there was a global effect of condition, the difference between the percentages of 'expected' responses in the oral and the mixed conditions was significant for the vowels /ɔ/, /ʌ/, and /ʊ/ only. Given that there is no reason to suppose that grapheme-to-phoneme correspondence rules are invoked with some but not all vowels, this suggests that the effect of orthography is masked for the remaining vowels /i/, /u/, /ɛ/, /æ/, and /ɪ/. Specifically, the strategy used in the oral condition might yield the same results for these vowels as those predicted by the grapheme-to-phoneme correspondence rules.[5]

In the mixed condition, the most frequent adaptation for all vowels was – not surprisingly – the one that is predicted by the between-language grapheme-to-phoneme strategy. We also obtained a certain amount of 'reading' adaptations, though. In particular, /ʌ/ (grapheme: <u>) was adapted as /y/ in 22.9% of the cases and /u/ (grapheme: <oo>) as /O/ in 4.9% of the cases. The vowel /ʊ/, also represented by the grapheme <oo>, was likewise adapted as /O/ in 6.3% of the cases; however, given that the same adaptation was also attested in a fair amount of cases in the oral condition, we cannot determine whether this is a 'reading' adaptation or not.

The only recurrent adaptation observed in the mixed condition that does not follow either the between-language grapheme-to-phoneme strategy or the 'reading' strategy is the adaptation of /ɛ/ as /∅/. This adaptation, attested in 15.6% of the cases, was also observed in the oral condition

[5] Moreover, for /ɛ/ and /æ/ there might be differences between the most frequent adaptations in the two input conditions that are invisible due to our use of the metacategories /E/ and /A/, respectively, in the transcriptions of the adaptations.

(in 13.9% of the cases), and arguably results from the presence of a very frequent alternation pattern in French verbs. That is, due to a phonotactic constraint that bans /ə/ in closed syllables, French has a fair amount of verbs that show an alternation between /ə/ and /ɛ/, with the former surfacing in open syllables such as in the past participle (e.g. *mené* [məne][6] '(have) lead'), and the latter in closed syllables such as in the first to third persons of the present tense (e.g. *mène* [mɛn] '(s/he) leads'). In analogy with this alternation, then, the vowel /ɛ/ in CVC-stimuli is adapted as /∅/ in the past participles of the form CVCV. We thus predict that when asked to produce the novel verbs in a present tense singular form rather than as past participles, participants would not produce /∅/.

In the oral condition, the most frequent adaptations were generally the same as those in the mixed condition.[7] This is not surprising, since whatever the strategy used in the oral condition, its results should overlap to a certain extent with those predicted by the grapheme-to-phoneme strategy that were found in the mixed condition. This is because, firstly, grapheme-to-phoneme correspondence rules are arguably based on the perception of L2 sounds, which depends upon phonetic proximity (see, for instance, Best, 1994), and, secondly, phonological and phonetic proximity often go hand in hand. Regardless of whether participants base their adaptations in the oral condition on phonological proximity, phonetic proximity, or some mixture of these, we can thus expect the results to be quite similar to those in the mixed condition.[8]

The adaptations in the oral condition were generally more varied, though, than those in the mixed condition. This variation is especially striking in the case of /ɛ/ and /ɔ/, which are part of the French vowel inventory but were both adapted as /A/ in a fair amount of cases (8.3% and 5.2%, respectively). We also found a considerable amount of talker-dependent variation in the oral condition. For instance, all adaptations of /ɪ/ as /∅/ and the great majority of adaptations of /ɔ/ as /A/ were caused by only one of the talkers (a woman with a mid-west accent). This same talker also provoked quite a different response pattern for /ʌ/ than the remaining three talkers, with more adaptations as /A/ and less as /O/. Likewise, /ɛ/ was adapted as /i/ in response to the stimuli of a single talker only (a man with a New York accent). Finally, one of the talkers (a man with a predominantly mid-west accent) caused larger percentages of adaptations of /ʊ/ as a front vowel than the remaining talkers; specifically, this talker was responsible for all of the adaptations as /y/ and for more than half of the adaptations as /∅/.

To sum up, we obtained differences in the response patterns in the mixed and the oral conditions, providing evidence that bilingual speakers are influenced by the written

[6] The quality of the first vowel is subject to dialectal variation: it can be produced as either [∅] or [œ]. Here we use the standard notation as proposed by the dictionary Le Petit Robert.

[7] Note, however, that due to the use of the metacategories /A/, /E/, /O/, and /∅/ in the transcriptions of the adaptations, there might be differences between the most frequent adaptations in the two conditions that we failed to observe.

[8] There is one vowel for which the most frequent adaptation in the oral condition differs from that in the mixed condition, i.e. /ʌ/; in the oral condition, this vowel was adapted most often as /O/ (rather than as /∅/). This discrepancy might be due to the fact that the grapheme-to-phoneme strategy is likely based on British English (BE), which until less than a century ago was more widespread in Europe than American English. Indeed, as observed by a reviewer, /ʌ/ is more fronted (end hence closer to French /∅/) in BE than in AE. Under the assumption that phonetic proximity plays a role in on-line adaptations, this would explain why our participants behaved differently with respect to /ʌ/ in the oral and the mixed condition: in the oral condition they produced the French vowel that is closest to the realization of /ʌ/ in the AE stimuli, whereas in the mixed condition they relied on the grapheme-to-phoneme correspondence rule established on the basis of the BE pronunciation of /ʌ/. Provided the phonetic realization of /ʌ/ in BE has not changed since the grapheme-to-phoneme correspondence rule was established, we thus predict that with BE rather than AE input stimuli we would obtain /∅/ as the most frequent adaptation.

representation of the words they adapt. Apart from 'reading' adaptations and adaptations that are influenced by a morphophonological alternation, the pattern of adaptations in the mixed condition corresponds to that observed in integrated loanwords. In the oral condition, the adaptations were more varied. In particular, AE vowels were not always adapted as the phonologically closest French vowel, and, moreover, different talkers provoked different response patterns. This suggests that the participants used a phonetically- rather than a phonologically-based strategy. Indeed, from a phonological point of view the stimuli were perfectly homogeneous, whereas from a phonetic point of view they showed both intra- and intertalker variability. Many researches have argued that phonetic proximity plays a role in loanword adaptations, be it restricted to special cases (Silverman, 1992; Yip, 1993; Takagi and Mann, 1994; Rose, 1999; Gbéto, 2000; Kim and Curtis, 2002; Kang, 2003; Kenstowicz, 2004), or extended to all loanword adaptations (Peperkamp and Dupoux, 2003; Vendelin and Peperkamp, 2004; Peperkamp, in press). More research is necessary to investigate if in the present case the English vowels are adapted as the phonetically closest French vowels that occur in closed syllables.[9]

3. Conclusion

Using an on-line adaptation task, we have shown that loanword adaptations are influenced by orthography. Even in the experimental setting that we used it remains hard to quantify this influence, for the following reasons. First of all, as mentioned before, given that between-language grapheme-to-phoneme correspondence rules are likely based on the L1 perception of L2 sounds, which depends on phonetic proximity, adaptations based on this strategy are often indistinguishable from adaptations based on phonological and/or phonetic minimality. The influence of orthography, then, is necessarily underestimated.

Second, even for words that are adapted on the basis of oral input, the influence of orthography cannot always be excluded, since bilingual adapters can recognize the words and their written form. In the present experiment, we therefore used non-words. However, some orthographic influence may still have arisen, since adapters can construct an orthographic representation of non-words that are phonologically similar to high-frequency real words. For instance, when presented with the non-word [fʌp], they can note the similarity to [kʌp] and construct an orthographic representation *fup* by analogy with *cup*. It would therefore be interesting to test monolingual French speakers in the oral condition, to see if their adaptations differ from those by our bilingual participants.

Third, recall that there are two types of orthographically-influenced adaptations, so-called 'reading' adaptations and adaptations based on between-language grapheme-to-phoneme correspondence rules. For some cases, these two types of adaptations are identical, while for others they are different. This makes it hard to examine the two types of possible influences

[9] In particular, we would need to record our French participants producing French vowels within the same consonantal frames as those used in our AE stimuli. This would allow us to compare the acoustic properties of vowels in the dialects of, on the one hand, the AE talkers and, on the other hand, the French adapters, in the same phonological contexts. Of course, we would also need to define a distance metric. F1 and F2 are obvious parameters in this metric, but it is unclear whether higher formants and/or vowel duration should be taken into account as well, and how the different parameters should be weighted. For instance, since there is no linear relationship between acoustic frequency and perceived pitch (a change from 300 to 500 Hz is not perceptually equivalent to a change from 2000 to 2200 Hz), a standard Euclidean distance metric, in which each formant equally contributes to the distance between two vowels, is inappropriate.

separately. In the present experiment, we were interested in the impact of between-language grapheme-to-phoneme correspondence rules and therefore selected advanced learners of English, who are less likely to exhibit 'reading' adaptations. We nonetheless observed a certain amount of adaptations that can only be interpreted as such. It would be interesting to see if testing even more proficient bilinguals would be a way to obtain no 'reading' adaptations at all.

Our findings have consequences for current research on loanword phonology, since they show that the data on which most phonological and phonetic analyses of adaptation patterns are based can be contaminated by the influence of orthography. Integrated loanwords, then, might not be the best source for studying phonological and phonetic principles in loanword adaptations. Rather, on-line adaptations based on orally presented non-words provide more reliable data. By way of example, we spell out two cases for which – in our view – an on-line adaptation experiment could shed light on the influence of orthography.

The first case concerns the Quebec French adaptation of AE [ɾ] as either /t/ or /d/, according to the underlying consonant: *heater* is adapted with /t/ and *grader* with /d/. An account offered by LaCharité and Paradis (2000) is that speakers of Quebec French recover the underlying consonants in English, either by comparing the source words to morphologically related words that do not contain [ɾ], such as *heat* and *grade* for the examples above, or – in the absence of such alternations – by relying on subtle phonetic cues such as vowel length. Paradis and LaCharité explicitly discard an orthographic account, arguing that if orthography were at play, we would need to see its impact everywhere, contrary to fact; for instance, English *up* is adapted as /ɔp/, not /yp/. Note, though, that this latter adaptation would be a 'reading' adaptation (recall that in French, the grapheme <u> is pronounced as /y/), while the adaptation of [ɾ] as /t,d/ might rather fall under the heading of grapheme-to-phoneme correspondence rule. Specifically, given that English school teachers in Quebec (except those who are native AE speakers) tend not to flap /t/ and /d/ (Yvan Rose, p.c.), Quebec French adults might base their adaptations on what they have learned in school, namely that the graphemes <t> and <d> simply correspond to /t/ and /d/, respectively. An experiment with on-line adaptations of orally presented non-words (e.g. *keater*, *nader*) spoken by native speakers of AE would allow us to test this hypothesis. In particular, we expect that the identity of the underlying phonemes (as revealed only to the AE talkers by the written representation of the non-words) does not reliably predict the nature of the adaptations, regardless of the participants' proficiency in English.

The second case in which an on-line adaptation experiment might help us understand the impact of orthography concerns English loanwords in Japanese. It is well-known that Japanese adapts illicit coda consonants by means of vowel epenthesis. However, Smith (to appear) shows that some English loanwords are exceptional in that they have two adapted forms, one with epenthesis and one with deletion. For instance, *pocket* has been adapted as both [pokːe] and [poketo]. According to Smith, the deletion cases are due to perception. That is, she argues that some consonants in the source words are not perceived by native speakers of Japanese. That the same loanwords are also adapted with an epenthetic vowel would be due to orthography. In particular, these latter adaptations would have been introduced on the basis of a written representation of the source words, with epenthesis being applied in order to preserve all segmental material.

Smith's analysis is somewhat surprising, since it has been demonstrated experimentally that native speakers of Japanese perceive an illusory vowel within consonant clusters (Dupoux et al., 1999); if anything, one would therefore expect the adaptations with *epenthesis* to be due to perception and the ones with deletion to something else. However, most of the deletion cases involve consonants that are not very salient, such as syllable- and word-final stops. It might therefore be the case that, at least during the time these loanwords were introduced, both

epenthesis and deletion arose in adaptations based on oral input. In this light, it is interesting to note that epenthesis and deletion can be found within the same word; for instance, one adaptation of *crank* is [ka.ɾaN], where the initial cluster has undergone epenthesis and the final one deletion. Of course, given the historical character of these loanwords, any conclusion based on Smith's data is unwarranted. By contrast, it is possible to investigate how much of epenthesis in novel loanwords is due to orthography (or, in other words, how much deletion can nowadays arise due to perception). Indeed, an on-line adaptation experiment like the one described in this paper, in which non-words are presented either with or without a written representation, would be helpful to shed light on this issue.

To conclude, loanword adaptations are an emergent phenomenon of languages in contact. It is our contention that they are best studied within an experimental framework, that allows one to examine a wide variety of factors that are likely to play a role in the nature of the adaptations, including phonetic variation, level of bilingualism, orthography, and prestige of the source language. It is only when all these different factors will be taken into account that a comprehensive theory of loanword adaptations will become within reach.

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Appendix A. Stimuli

Training

/ʃɛb/	/ʃɔb/	/zʊt/	/zɔt/
sheb	shob	zoot	zot

Test

/fip/	/fup/	/fɛp/	/fɔp/	/fæp/	/fʌp/	/fɪp/	/fʊp/
feap	foop	fep	fop	fap	fup	fip	foop
/mib/	/mub/	/mɛb/	/mɔb/	/mæb/	/mʌb/	/mɪb/	/mʊb/
meab	moob	meb	mob	mab	mub	mib	moob
/pid/	/pud/	/pɛd/	/pɔd/	/pæd/	/pʌd/	/pɪd/	/pʊd/
pead	pood	ped	pod	pad	pud	pid	pood

Appendix B. Carrier sentences

"Les syndicats ont ... la proposition du gouvernement."
"La commission a ... ce nouveau projet."
"Le conseil municipal a ... une décision importante."
"Le ministère a ... ses dépenses annuelles."
"Cette association a ... son programme d'activités."
"Cette enterprise a ... un nouveau logiciel."

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