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# Loanword Phonology

Jennifer L. Smith
University of North Carolina at Chapel Hill

## 1. Introduction

This chapter addresses basic concepts, research topics, and key proposals concerning loanword phonology, as well as some of the implications that loanwords and loanword adaptation have for fundamental questions in phonological theory. After a brief historical overview in section 2, the chapter focuses primarily on contributions to experimental and theoretical work published after 2011, subsequent to the extensive review of loanword phonology by Kang (2011; see also Kang 2013 for an annotated bibliography) and the theoretical and methodological overview by Paradis & LaCharité (2011). Section 3 discusses non-phonological factors that influence loanword phonology: phonetics and perception, orthography, and social context. Section 4 reviews recent applications of loanword phonology as evidence in phonological theory. Conclusions are presented in section 5.

Before beginning a discussion of the role of loanword phonology in phonological theory, however, it is important to clarify what is meant by the terms *loanword* and *loanword phonology*.

### 1.1 Loanwords: From source language to borrowing language

A *loanword* can be defined as a word introduced to one language, the *borrowing language* or $L_b$, from another language, the *source language* or $L_s$. This discussion focuses specifically on loanwords whose *phonological shape* (or an approximation thereof) is introduced into $L_b$ along with its meaning. Such phonological loanwords can be distinguished from the class of borrowings called *semantic loans, calques,* or *loan translations,* in which pre-existing $L_b$ morphemes are used to express a borrowed concept that is the translation of an $L_s$ form or expression. Loanwords must also be distinguished from *code-switches*, defined by Poplack (2018: chapter 1) as "alternation[s...] of stretches of one language with stretches of another, each retaining the morphology, syntax, and optionally the phonology" of its language of origin. How, and even whether, to distinguish borrowing from code-switching has been controversial, but Poplack argues that any form that is morphosyntactically integrated into $L_b$ is not a code-switch, even if it is a novel or one-time borrowing.

In some cases, a loanword includes phonological structures or sequences that are identical (or at least similar) to aspects of the $L_S$ source form but are not found in the non-loan phonology of $L_B$, as when English speakers produce the name *Bach* with a final velar fricative [x] corresponding to the German source form; such non-native structures are said to be *imported* (Haugen 1950). In other cases, some or all non-$L_B$-like phonological structures or sequences are brought into conformity with the $L_B$ phonological system, as when English speakers produce the word *tempura*, borrowed from Japanese [tempɯra], with a rhotic approximant [ɹ] replacing the $L_S$ tap [ɾ], a rounded [u] replacing the $L_S$ unrounded [ɯ], a reduced [ə] replacing the $L_S$ low central [a], and a word stress (on [u]). Such differences between the $L_B$ and $L_S$ shapes of a loanword are known as *adaptations* or *nativizations*. The mechanisms by which loanwords are adapted are complex and have been the subject of much research and debate (section 3).

In summary, the term *loanword* is used in this chapter to refer to a word introduced to $L_B$ from $L_S$, whose sound shape is based on that of $L_S$ (possibly subject to adaptation), and which is not a code-switch.

## 1.2 Loanword phonology: Established loanwords versus loanword adaptation

The term *loanword phonology* has been used to refer to two different, though related, phenomena. Sometimes this term refers to *phonological generalizations about established, lexicalized loanwords* in $L_B$, often with a focus on how the phonology of such loanwords compares, either to the $L_S$-internal phonology of the source words, or to the non-loan phonology of $L_B$. Loanword-specific phonological patterns can involve a variety of aspects, including phoneme inventory, phonotactic restrictions, prosodic structure, or phonological alternations.

In other cases, the term *loanword phonology* is used in reference to *loanword adaptation*, the phonological (though see also section 3) changes that accompany the real-time introduction of a new loan from $L_S$ into $L_B$.

These two aspects can also become intermingled, because even loanwords that are now established must have been borrowed for the first time at some point. In addition, generalizations concerning the phonology of established loanwords can become conventionalized within the $L_B$ community, leading to predictable or systematic strategies for adapting newly introduced loanwords (section 3.3).

In this chapter, *loanword adaptation* will be distinguished from *phonological generalizations over established loanwords* where maintaining the distinction is relevant, and the more general term

*loanword phonology* will be used where considering both aspects together is useful, or where the two cannot easily be disentangled.

## 2. A brief history of loanword phonology

Figure 1 reports the usage of the terms *loanword* (or *loan word*) *phonology* and *loanword* (or *loan word*) *adaptation* in the "English 2019" Google Books corpus, using the Google Ngrams tool (Michel *et al.* 2011). The results of this simple corpus search provide some general context for the discussion in this chapter, although these usage counts are not a direct measure of the rate of occurrence of the search terms in academic publications.

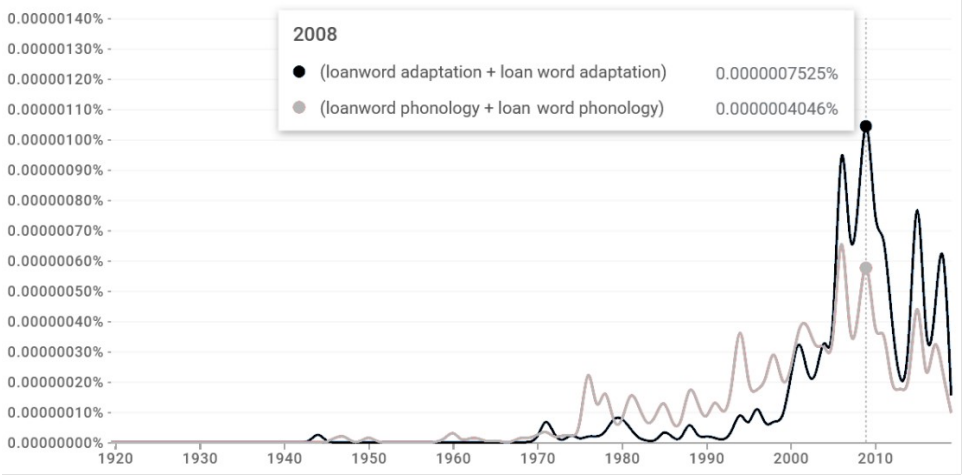


Figure 1. Google Ngrams results for *loan( )word adaptation* and *loan( )word phonology* in the "English 2019" corpus, raw data (no smoothing). From [http://books.google.com/ngrams].

The corpus results show a small amount of activity for *loanword phonology* in the late 1940s to 1950, and again in the 1960s; then there is an uptick around 1975, followed by another increase around 1995, with a maximum around 2006. Similarly, *loanword adaptation* shows a small amount of activity around 1943, then activity starting again around 1971, with a peak around 2008. The term *loanword phonology* is more common at first, but *loanword adaptation* catches up around 2000 and becomes the more commonly used of the two after that.

The uptick in the use of these terms in the 1970s corresponds, chronologically, to an interest in loanword data as external evidence for phonological grammars and as evidence for or against particular theoretical proposals in early generative phonology (section 2.2). The increase in the 1990s lines up with the development of Optimality Theory and other constraint-based approaches,

which reconsidered some fundamental assumptions about the nature of the phonological grammar, making evidence from loanwords relevant in new ways (section 2.3). The emerging preference for the term *loanword adaptation* co-occurs with an increased interest in determining the degree to which factors beyond the $L_b$ phonological grammar, especially phonetic similarity and perceptual illusions (section 3.1), contribute to the differences in phonological shape between loans in $L_b$ and their $L_s$ source forms.

Although the most recent years show fewer instances of both search terms than at their peaks around 2006–2008, interest in loanword phonology and loanword adaptation continues. With appropriate attention to non-phonological factors (section 3), and the incorporation of a variety of methodologies (section 4.1), evidence from loanwords continues to bear on our understanding of the phonological grammar and its interfaces with phonetic, orthographic, and social factors.

## 2.1 Haugen (1950)

One of the first systematic discussions of loanwords and loanword phonology is that by Haugen (1950), who sets out to establish fundamental concepts and terminology related to linguistic borrowing and to posit general hypotheses about the process of borrowing and its linguistic and social context.

Haugen is primarily interested in loanwords and their properties as a means to investigate the process of linguistic borrowing itself. This perspective stands in contrast to that of later generations of researchers who would consider the role of loanword phonology as a source of evidence about broader aspects of human language and cognition. Nevertheless, in the course of his discussion, Haugen identifies a number of issues and questions that are still of current interest. For example, he distinguishes between adaptation (which he calls "substitution") and importation in the phonology of loanwords, and he hypothesizes that lower proficiency in $L_s$ leads to more adaptation of non-$L_b$ phonological structures. He also observes that patterns seen in loanwords can be gradiently foreign rather than falling on either side of a well-defined boundary between native and foreign. He flags orthographic influence as a potential complicating factor in loanword phonology. Additionally, Haugen notes that speakers' use of established loanwords is not strictly the same phenomenon as the initial process of borrowing, but he suggests that patterns in established loans can nevertheless shed light on that initial process.

## 2.2 Loanwords in early generative phonology

With the development of generative phonology came both an interest in using loanword phonology as a source of external evidence for proposals about the phonological grammar of a particular language, and exploration of the theoretical implications of languages with loanword-specific phonological patterns.

Hyman (1970a, b) is one of the first to emphasize that loanwords can provide an important source of what would come to be known as *substantive* or *external evidence* in phonology (Kiparsky 1982 [1971]; Skousen 1972; Botha 1973; Zwicky 1975; Churma 1979), defined by Zwicky (1975) as any source of data bearing on the phonological grammar beyond morpheme alternations and patterns of phonological distribution. Hyman takes the position that, if the goal of linguistic analysis is no longer merely a description of the patterns observed in a language, but rather a model of the generative linguistic system of the language itself, then external evidence becomes necessary for deciding between multiple possible phonological analyses of a language. Hyman's discussion focuses on loanword adaptation (and the perception of foreign forms more generally) as one source of external evidence. He argues that, if a posited phonological rule can be shown to apply to an $L_s$ form when it is adapted to $L_b$, this shows that the rule is productive and thus is a psychologically real part of the phonological grammar of $L_b$.

Also of interest in early generative phonology were *lexical strata* — lexical subclasses with distinct phonological properties that arise when $L_s$ structures are imported rather than adapted, leading to phonological contrasts or syllable structures that are permitted only in loanwords. In a rule-based framework, this motivates rules or exceptions that must apply to entire subsets of the lexicon (Chomsky & Halle 1968; Kiparsky 1968; Saciuk 1969).

## 2.3 Loanword phonology in constraint-based models

Although loanword phonology can be a source of external evidence for phonological grammars, it also presents complications for a rule-based phonological model. The development of constraint-based frameworks such as Optimality Theory (OT; Prince & Smolensky 2004 [1993]) and the Theory of Constraints and Repair Strategies (TCRS; Paradis & LaCharité 1997, 2011) allowed new perspectives on some of these issues.

One problem is that a rule-based analysis of loanword phonology can require multiple formal devices that derive the same surface pattern — a situation known as a *conspiracy* or a *duplication problem* (Kisseberth 1970; Clayton 1976), often viewed as the sign of a missed generalization. For

example, consider a language with no surface onset clusters, but also with no morphological alternations overtly resolving onset clusters, because no potential clusters happen to occur in monomorphemic URs or in morpheme combinations. In a classic rule-based approach, the absence of URs with potential clusters would be modeled by means of a morpheme-structure condition (Stanley 1967) prohibiting such structures in lexical entries. Now suppose that the same language has a process of epenthesis into onset clusters in loanword adaptation (and that the epenthesis is phonological; see section 3.1.2). This adaptation process would serve as external evidence that the onset-cluster prohibition is productive in $L_b$. And yet, the phonological analysis of this language must now include an epenthesis rule that is needed only for loanwords, and moreover such a rule forms a conspiracy with the morpheme-structure condition that is needed to account for the absence of onset clusters in non-loan forms. (See Stampe (1973) for more on problems raised by loanword adaptation for Chomsky & Halle's (1968) approach to morpheme-structure conditions.)

The picture is different in a constraint-based model. If the phonological grammar consists of, not a series of ordered rules, but a hierarchy of output constraints, then loanword adaptation is actually expected, even in the absence of active alternations in the non-loan phonology. To continue the example from above, if an onset-cluster prohibition is *productive* in $L_b$, then a constraint against onset clusters (*COMPLEXONSET) dominates at least one of the faithfulness constraints that would protect any potential complex onset that might arise (Smolensky 1996). This high rank for *COMPLEXONSET automatically predicts that onset clusters are avoided in loanwords.

In OT and related frameworks, then, patterns of loanword adaptation can be seen as external evidence not only for the productivity of a particular phonological process, but more specifically for the presence of a high-ranking constraint in the grammar of a language. Early approaches to loanword phonology in constraint-based models often emphasize this line of thinking: see, for example, Yip (1993); Paradis (1995); Paradis & LaCharité (1997); Broselow (2000); Jacobs & Gussenhoven (2000); Shinohara (2004). Questions remain, however: for example, high-ranking markedness constraints account for why the structures that are absent from $L_b$ are also those that are repaired in loanword adaptation, but they do not necessarily predict *which* of the many possible adaptation strategies are applied.

Constraint-based models also provide new approaches to modeling lexical strata created by borrowing, including constraint rankings that vary by stratum (J. Ito & Mester 1995; Inkelas & Zoll 2007) and constraints that are indexed to specific strata (Fukazawa *et al.* 1998; J. Ito & Mester 1999).

The heightened interest in loanword phonology sparked by the development of constraint-based phonological frameworks produced several books and special issues of journals (Kenstowicz & Uffmann 2006; Calabrese & Wetzels 2009; Kenstowicz & Cabré 2012), as well as review articles (Kang 2011; Paradis & LaCharité 2011), within roughly the first decade of the 21st century. Kang (2011) is a particularly useful overview addressing the new insights that come from viewing questions of loanword phonology, especially loanword adaptation, from a constraint-based perspective. Kang discusses the role of loanword phonology as external evidence and summarizes key debates over factors involved in loanword adaptation, including the phonology/phonetics debate (see section 3.1) and the extent to which universal factors explain languages' choice of loanword repair. Paradis & LaCharité (2011) focus on arguments in favor of phonological factors in loanword adaptation and make methodological recommendations for research in loanword phonology, such as using large corpora, considering only cases where a form from $L_s$ is borrowed directly into $L_b$ without intermediate borrowings in other languages, and controlling for the effects of non-phonological factors (see section 3).

## 3. Non-phonological factors

Loanwords have long been regarded as a source of external evidence for the phonological grammar — a way to confirm the productivity of phonological processes, for example, or a way to test claims about representations or constraints (section 2). From the earliest studies, however, it has been clear that loanword sound shapes can also be affected by factors beyond the phonological grammar, especially phonetics and perception, orthography, and social context. A full understanding of loanword phonology and its implications for phonological theory therefore requires an understanding of how and under what circumstances such non-phonological factors contribute to loanword adaptation or phonological generalizations over loanwords.

### 3.1 Phonetics and perception

Phonetic factors, including *phonetic similarity* and *perceptual illusions*, are a major non-phonological influence on the process of loanword adaptation. There is a body of literature debating whether adaptation should be seen as "primarily" phonological or phonetic (see Kang 2011 and Paradis & LaCharité 2011 for discussion), but Kang (2011) concludes that it is too simplistic to view this as an either/or question. Recent studies showing combined effects of phonetic and phonological factors, sometimes explicitly investigating the circumstances under which particular factors predominate, include Daland *et al.* (2015); Durvasula & Kahng (2015); Louriz (2015); Al-Hashmi (2016); Guba

(2016); Kang *et al.* (2016); Jian (2017); Durvasula *et al.* (2018); Huang & Lin (2019); Yun (2019); Phetkla (2020); Glewwe (2021); Kang & Schertz (2021); Kim (2021); He & He (2022); Chen & Lu (2022); Alenazi (2023); and Laidler (2023).

### *3.1.1 Phonetic similarity*

To the extent that $L_b$ speakers intend (consciously or not) to produce a loanword in a way that *sounds* as similar as possible to its $L_s$ form, then modifications to the $L_s$ form made during loanword adaptation are likely to be influenced by *phonetic similarity* (Silverman 1992; Kang 2003). Recent evidence for such phonetic influence is provided by Ryu *et al.* (2020), who find a strong effect of $L_s$ phonetic duration on whether a diphthong in a loanword from Mandarin into a Chinese variety of Korean is realized as a diphthong or adapted as a monophthong. Other examples include C. Ito & Kenstowicz (2015), who show that changes over time in the phonetic correlates of laryngeal contrasts in $L_s$ Japanese and $L_b$ Korean have changed loanword adaptation patterns, and Peperkamp (2015), who finds an effect of coarticulation from the surrounding consonant context — a phonetic rather than phonological factor — on participants' judgments when adapting English vowels into French.

At the same time, studies such as Batais (2013), Stoltzfus (2014), Natvig (2017), Kennard & Lahiri (2020), and Yeung (2020) continue to support a role for phonological factors, including prosodic-structure requirements and formal properties of feature systems, in loanword adaptation.

### *3.1.2 Perceptual illusions*

The way an acoustic signal is initially perceived by a listener and assigned a phonological structure can be influenced by the listener's phonological system (Massaro & Cohen 1983). Consequently, some differences between an $L_b$ loanword and its $L_s$ source form might not be the output of the phonological production grammar at all — that is, might not be phonological processes applied to an $L_s$ form that an $L_b$ speaker judges to be illicit — but instead might simply reflect how the $L_b$ speaker (inaccurately) perceives the $L_s$ form.

Dupoux *et al.* (1999) provide evidence for just this type of *perceptual illusion*, concerning epenthesis. Japanese loanwords typically repair any illicit codas or consonant clusters from $L_s$ source forms with the insertion of [ɯ] (Lovins 1973). Dupoux *et al.* find that Japanese-speaking listeners are much more likely than French-speaking listeners to perceive a medial [ɯ] between consonants in a (non-word) stimulus such as *abge*, which is phonotactically illegal in Japanese. In addition, Japanese listeners are significantly less likely than French listeners to distinguish between

stimuli such as *abge* and a*b*[ɯ]*ge*. These results indicate that Japanese listeners experience a perceptual illusion when they hear stimuli such as *abge*, perceiving a*b*[ɯ]*ge* instead.

Peperkamp & Dupoux (2003) propose that *all* loanword adaptation (that is not orthographic) is a result of perceptual illusions of this kind (see also Boersma & Hamann 2009). This proposal has a significant consequence: There can be no role for the $L_b$ production grammar to modify illegal structures in the $L_s$ source form if the $L_b$ listener never perceives such $L_b$-illicit structures in the first place. On this view, it is not just that perceptual similarity plays a role in loanword adaptation; instead, loanword adaptation would not be a matter for the phonological production grammar at all. Arguments in favor of perceptual illusions as a key factor in loanword adaptation are also made by Jacobs (2014) and Blevins (2017). Guevara-Rukoz *et al.* (2017), Guevara-Rukoz *et al.* (2021), and Song (2022) explore the extent to which perceptual illusion effects can even predict the quality of epenthetic vowels that appear when loanwords are adapted.

On the other hand, evidence has been accumulating against the strong view that loanword adaptation is always the result of perceptual illusions (Smith 2006; Uffmann 2006; Kabak & Idsardi 2007). Evidence that $L_b$ speakers can sometimes perceive $L_s$ contrasts is provided by Radomski (2019) and Zuraw *et al.* (2019); another example would be the "Oprah effect" (Jurgec 2014), in which $L_s$ structures are adapted when loanwords undergo morphological derivation, but are faithfully imported in morphologically simple loanwords. Other studies arguing that adaptation by perception cannot be the whole story — often because the results of perception experiments differ from loanword adaptation patterns — include De Jong & Cho (2012); Dong (2012); Mattingley *et al.* (2015); Huang & Lin (2016); Szpyra-Kozłowska (2016); and Daland *et al.* (2019).

### 3.2 Orthography

Loanwords borrowed from written sources may show different phonological patterns or $L_s$/$L_b$ structural correspondences from those borrowed orally, a fact that has been noted for some time (Bloomfield 1933; Haugen 1950; Lovins 1973). Orthographic effects have also entered the perception/phonology debate (section 3.1), with proponents of each side sometimes relegating examples that seem to support the other position to "mere" orthographic effects. As with phonetic and perceptual factors, however, it is important to investigate the influence of orthography on loanword phonology systematically in order to understand how orthography interacts with phonology (and phonetics).

### *3.2.1 Evidence from descriptions of established loanwords*

Relatively strong evidence for orthographic influence on loanwords comes from $L_b$ forms that encode information represented in $L_s$ only in writing and not in speech. Segments in the surface form of a loanword in $L_b$ that correspond to "silent" units in the $L_s$ orthographic representation, with no reflex in the $L_s$ surface form, are reported by Duběda (2014) in loanwords from French into Czech, by Cohen (2019) in loanwords from English into Hebrew, and by Yun (2019) in loanwords from English into Telugu. Similarly, Cohen (2019) and Beckham (2019) discuss $L_b$ forms that reflect distinctions made in the $L_s$ orthography but not in the spoken language.

Sometimes, the $L_b$ form of a loanword is unexpected from a phonetic or phonological perspective, but plausible as the result of influence from $L_s$ orthography. Szpyra-Kozłowska (2016) discusses the outcomes of $L_s$ English /ɪ/ in a corpus of established loanwords in Polish, where the most phonetically similar $L_b$ category should be /ɨ/. She presents examples that appear to be conditioned by a $L_b$-influenced interpretation of the $L_s$ vowel spelling: $L_s$ /ɪ/ corresponding to $L_b$ /i/ when spelled <i> in $L_s$, to $L_b$ /ɨ/ when spelled <y>, to $L_b$ /ɛ/ when spelled <e>, and to $L_b$ /ɛj/ when spelled <ey> or <ay>. Approximately 84.5% of the 700 English loans with /ɪ/ in Szpyra-Kozłowska's corpus are consistent with these orthographic generalizations, although phonological factors also predict some of the same patterns. A similar effect is reported by Laidler (2023), who examines loanwords into Russian whose source forms contain (British) English /ɜ:/. Shafi (2017) elicits productions of established loanwords into Mirpur Pahari from English, and attributes to orthographic effects both the avoidance of consonant deletion and also certain patterns of stress variation in the $L_b$ forms of loanwords.

Damulakis & Nevins (2022) discuss an interesting pattern in Brazilian Portuguese involving an orthographic version of the "Oprah effect" (Jurgec 2014), that is, a pattern in which an imported (non-$L_b$) phoneme is maintained when a loan is morphologically underived in $L_b$ but undergoes adaptation in morphologically complex forms. In this case, involving loans from English, French, and German, once the morphological context requires the imported phoneme to become adapted, the outcome of adaptation is not a phonetically similar $L_b$ vowel, but instead is determined by an $L_b$ grapheme-to-phoneme interpretation of the ($L_s$) orthographic form. For example, the English noun *bug* [bʌg] is borrowed with an imported vowel /ɐ/ (marginal in $L_b$ non-loans) as *b*[ɐ]*g*, but in the derived verb *b*[u]*gar* 'to bug out', the vowel is adapted not to the phonetically similar [a], but to the orthographically signaled [u].

As seen in the cases discussed so far, orthographic influence on loanwords is typically caused by the L*s* form. A different kind of effect, based in properties of the L*b* orthographic system, is found in Chinese languages, in the class of loanwords known in Chinese linguistics as *transliterations* (Cook 2018). This type of loanword is written with *hanzi* characters — which typically represent a specific morpheme, that is, a particular meaning as well as a sound shape — but in the loanword are used for their sound value alone. A transliteration, therefore, is an adaptation of the sound shape of the L*s* form in terms of *orthographically* permissible syllables in L*b*. Cook (2018: 12) provides the example of Mandarin 伊妹儿 [i$^{55}$-meɪ$^{51}$-ɑɻ$^{35}$], where the *hanzi* graphemes, if representing morphemes, would translate (meaninglessly) as 'he/she-little.sister-son', but are used in this word to represent a transliteration loan from the English L*s* form *email*.

In a situation like that of the Chinese transliteration loans, if the orthographically permissible syllables are a subset of the phonologically permissible syllables, then the L*b* forms of loanwords may include mismatches with the L*s* source words that are driven not by the phonology of either language, or even by L*b* perception, but purely by L*b* orthographic considerations. L*b* speakers could, of course, maintain L*s*-based spoken distinctions in loanwords even when these distinctions are not represented in the L*b* orthography, but if the L*b* spoken forms are consistent with their L*b* orthographic representations, this constitutes L*b*-driven orthographic interference in loanword phonology. To see the effects of this kind of L*b* orthographic filter, it is useful to contrast transliteration loans in Mandarin with what Cook (2018) calls *wholesale loans*, in which the L*s* (often English) orthography is borrowed along with the semantics and (an adaptation of) the phonological shape. One example is Mandarin *OK* (from English *OK*), which includes the syllable [k$^{h}$eɪ], a C+V combination that corresponds to no *hanzi* character and thus could not be represented in a transliteration loanword (Cook 2018: 19). Other cases of possible L*b* orthographic effects on the sound shape of loanwords in Mandarin are discussed by Hsieh *et al.* (2009: 240, note 7) and Chang (2020).

### *3.2.2 Experimental evidence*

Orthographic effects are most clearly visible when they lead to L*b* outcomes that are distinct from phonological and perceptual factors. However, orthography might influence loanword phonology even in cases where it is indistinguishable from the influence of phonological or perceptual factors (Vendelin & Peperkamp 2006; Crawford 2009; Daland *et al.* 2015). Consequently, a deeper

understanding of the role of orthography requires experiments or analyses that explicitly control for non-orthographic factors.

In one of the first such studies, Vendelin & Peperkamp (2006) present French bilingual speakers with English-like nonce words to be adapted into French under two conditions: one with only auditory presentation of the stimuli, and one with both auditory and orthographic presentation. They find that for some vowel categories, there is a difference in the most frequently chosen French vowel between the two conditions — demonstrating that orthography can indeed influence adaptation. This initial study has inspired similar experiments for other language contexts, including Al-Hashmi (2016), as well as Daland *et al.* (2015), whose Perceptual Uncertainty Hypothesis proposes that orthography plays a greater role in loanword adaptation when perceptual information underdetermines the $L_b$ phonological parse.

### *3.2.3 Phonological models incorporating orthographic influence*

If information coming from an orthographic representation can have an effect on phonological behavior, then the phonological grammar must have access to orthographic information. One way of modeling this is to propose that speakers' phonological representations of $L_s$ forms can include information acquired from multiple sources. For example, Smith (2009) models loanword adaptation with a *posited $L_s$ representation*, a repository for all the information the $L_b$ speaker has about the $L_s$ source form, along with an associated correspondence relation (McCarthy & Prince 1999) that allows for faithfulness to this representation. Crucially, the posited $L_s$ representation may include information received from multiple sources, including perception, orthography, and knowledge of $L_b$ phonology — whether that information is accurate, or distorted from the $L_s$ form by $L_b$ perceptual filtering or orthographic misparsing. Mathieu (2012) proposes a single input representation that includes perceptual and orthographic information simultaneously, along with faithfulness constraints specific to orthographic and to phonological material respectively.

Along similar lines, but implemented as an extension of the Bidirectional Phonetics and Phonology framework (Boersma 2011), is the model developed by Hamann & Colombo (2017). In this model, the phonological *surface form* (which itself corresponds to a lexical *underlying form* at a higher level of representation) stands in correspondence with two distinct representations: the *auditory form*, as in Boersma (2011), and here also the *orthographic form*. Distinct sets of correspondence constraints link the surface form to the auditory form and the orthographic form — *CUE* constraints and *ORTH(ographic)* constraints respectively — and these can be ranked with respect

to each other and with respect to the *structural* (markedness) constraints that hold of the surface form. Hamann & Colombo present this model as a general model of reading and writing that can also account for orthographic effects in loanword adaptation, including cases where orthographic effects occur along with auditory effects.

Hamann & Colombo's (2017) analysis of loanwords from English into Italian applies the $L_b$-internal ORTH constraints directly to loans from $L_s$ (with their $L_s$ orthography). As Hamann & Colombo note, this strategy is only available if $L_s$ and $L_b$ share an alphabet (or other system of glyphs). Vendelin & Peperkamp (2006), in their discussion of orthographic effects on loanwords from English into French (section 3.2.2), raise the possibility that French speakers have learned a set of grapheme($L_s$)-to-phoneme($L_b$) mappings, which are potentially distinct from orthographic mappings within $L_b$; in cases like this, Hamann & Colombo's approach would need to be augmented with additional ORTH constraints relating $L_s$ orthography directly to $L_b$ forms. Overall, however, the general insight behind their proposal seems appealing, especially the ability for orthographic constraints to be in the same grammatical system as, and ranked with respect to, phonological constraints, while representations for orthographic and acoustic information remain distinct. Damulakis & Nevins (2022), in their analysis of the orthographic "Oprah effect" (section 3.2.1), formalize their account in terms of Hamann & Colombo's model.

Important questions nevertheless remain with respect to the formal modeling of orthographic effects on loanword phonology. Hamann & Colombo's model would seem to allow any possible combination of auditory and orthographic properties to determine the shape of loanwords in $L_b$, but if Daland *et al.* (2015) are right that orthographic effects matter more when perceptual effects are less available, is this something that the model should encode? Are there properties that are cross-linguistically more likely to be influenced by orthography or by perception, and if so, why?

### *3.2.4 Summary*

As evidence accumulates concerning orthographic influence on the $L_b$ forms of loanwords, experiments uncover more details about the context and degree of such influence, and formal models that include orthographic effects on loanwords are developed and tested, our understanding moves beyond the traditional view that orthographic influence is nothing but a source of error in loanword phonology. Making the contribution of orthographic influence explicit can help clarify the role of factors like perception and the $L_b$ grammar in loanword phonology. Including orthographic

influence in formal phonological models can potentially shed light on the question of how the phonological grammar itself interacts with written language in the context of a literate society.

## 3.3 Social context

Given that the act of borrowing a word into a language is a type of language contact, it is unsurprising that social factors can influence how loanwords are adapted and become established in a community. There are many options for integrating an $L_s$ form into $L_b$: Do non-$L_b$ phonological structures tend to be imported, or adapted? Are adaptation strategies generally based on the $L_b$ or $L_s$ phonological grammar, or speech perception (section 3.1), or orthographic factors (section 3.2), or some combination? Have adaptation strategies become conventionalized, so that even speakers who are highly proficient in $L_s$ systematically adapt loanwords to "fit" $L_b$? The answers to questions like these for any individual borrowing situation are potentially influenced by the social context. Consequently, it is important to determine how social factors interact with the phonology of loanwords, so that such factors can be controlled for in considering the implications of loanwords for phonological theory.

This section discusses proficiency in $L_s$, identity construction and attitude toward $L_s$, and community-based conventionalization of loanword adaptation strategies. For more about borrowing in the broader context of language contact, see Thomason & Kaufman (1988), Van Coetsem (1988, 2000), Simonović (2015), and Poplack (2018). For a general discussion of methodologies for studying language contact and language variation in multilingual communities, see Ravindranath (2015).

### *3.3.1 Proficiency in $L_s$*

As Haugen (1950) hypothesized, $L_b$ speakers' familiarity with or proficiency in $L_s$ can influence the relative rate of importing non-$L_b$ phonological structures in loanwords. For example, Kadenge & Mudzingwa (2012) find that monolingual chiShona speakers consistently nativize non-$L_b$ segments and syllable structures in loanwords from English, while bilingual speakers import /l/, post-nasal voiceless obstruents, and onset clusters. In Sa'aida's (2015) study of English loanwords in Jordanian Urban Arabic among female students at the University of Jordan, participants specializing in English and with a history of English as the medium of instruction both use more English loanwords in general, and import more $L_s$ segment categories and final consonant clusters, than participants studying other subjects and with a history of Arabic-medium instruction.

Not only the speaker's $L_s$ proficiency, but even the speaker's perception of the interlocutors' $L_s$ proficiency, can be a factor in determining whether loanwords are nativized. Lev-Ari *et al.* (2014) perform a statistical analysis of Spanish loanwords in Mexicano, including both established loans and spontaneous borrowings, elicited in a conversation task. They find no effect of the speaker's own degree of bilingualism on the choice between retaining or nativizing non-$L_b$ segments and consonant clusters in the loanwords. However, they do find an effect of the factor they call "interlocutors' bilingualism," coded as 'high' if at least 75% of the participants in the conversation where the loanword was produced were considered by a research consultant from the community to both speak and understand Spanish, and as 'low' otherwise.

Not only the choice between importation and adaptation of $L_s$ structures, but also the types of adaptation, can differ based on $L_b$ speakers' proficiency in $L_s$. A number of studies assessing the interaction of $L_s$ proficiency and perceptual factors in loanword or nonce-loan adaptation find that lower levels of proficiency in $L_s$ correlate with stronger effects of phonetic and perceptual factors (section 3.1) on adaptation patterns. Nomura and Ishikawa (2018) compare the perception of English words by Japanese speakers classified as either introductory or intermediate English-language learners, finding that the intermediate learners have a slightly lower rate of perceptual epenthesis. Stronger perceptual similarity effects for $L_b$ speakers with lower $L_s$ proficiency are reported by Huang & Lin (2016), Kwon (2017), and Wang (2023).

Bilingual speakers are not necessarily immune to the influence of perceptual similarity, however. Aktürk-Drake (2014) looks at the adaptation of Swedish loanwords into Turkish by speakers of Turkish who are bilingual in Swedish, and finds that phonetically long (but phonologically short) Swedish vowels are adapted as long vowels in Turkish, while phonologically long (but phonetically not very long) Swedish consonants are adapted as short consonants — the surface, phonetic length determines the adaptation even though the speakers are bilingual.

### *3.3.2 Attitudes and identity*

Beyond the effects of $L_s$ proficiency in loanword adaptation and loanword phonology, other social factors can influence how loanwords are adapted or produced by $L_b$ speakers. In particular, when there is variation in the pronunciation of loanwords, a number of social or identity-related factors have been shown to play a role.

One such factor is the social attitude of $L_b$ speakers toward $L_s$ language and culture (Weinreich 1968). Paradis & LaCharité (2012) propose that the degree to which $L_s$ is considered prestigious by

$L_b$ speakers can influence the choice of strategy for adapting $L_s$ phonemes. When $L_s$ is held in high prestige, they argue, $L_b$ speakers may opt for a "flawed production-based attempt" to import an $L_s$ phoneme, resulting in an adaptation that is more perceptually similar to the $L_s$ source phoneme than would otherwise be predicted. Jaggers (2018) finds that the attitudes of American English speakers toward the source of a loanword contribute to the likelihood for a given speaker to use a more $L_s$-like or a more $L_b$-adapted pronunciation of a loanword, such as a foreign place name.

At a more fine-grained situational level, Lev-Ari & Peperkamp (2014) and Lev-Ari *et al.* (2014) find, for Hebrew and Mexicano respectively, that the degree of adaptation of $L_s$ sounds in loanwords can be influenced by the prestige of the donor language within the semantic domain of the loanword. Similarly, Hashimoto (2019a, b) reports that the choice of a more or less $L_s$-like pronunciation of loanwords from Māori into New Zealand English is influenced by situational factors such as the topic of discussion as well as by a given speaker's attitude toward $L_s$.

Also relevant are attitudes, not just toward the language or culture that is the source of a particular loanword, but toward language or cultural contact more generally. Jaggers (2018) looks at loanwords in American English that show variation between more and less $L_s$-like pronunciations, analyzing the effect of various social predictors. He finds some effect of political identity, and (as noted above) of attitude toward $L_s$ specifically, but the strongest social predictor of more $L_s$-like pronunciations is the speaker's degree of alignment with a globalist, rather than a nationalist, ideology. A general effect of openness to contact is also found by Jaggers & Baese-Berk (2020) in an experiment on listeners' representation of ambiguous acoustic cues. American English speakers heard C(ə)CVC nonce loanwords, where (ə) varied along a duration and intensity continuum from nothing ([CCVC]) to a full schwa ([CəCVC]); the onset clusters in the CCVC interpretations were legal in English, so this was not a potential case of perceptual illusion (section 3.1.2). The more highly speakers rate themselves as open to traveling, learning foreign languages, and pronouncing foreign names close to their original pronunciations, the more likely they are to represent an ambiguous acoustic cue (from the non-endpoints of the continuum) as a full /ə/ for a word that was presented as a loanword.

As with other sociolinguistic, especially sociophonetic, variables (Eckert 2019), the importation versus adaptation of $L_s$ phonological characteristics can be used by speakers to express aspects of their identity. For example, the political identity of the speaker is one factor that predicts more versus less $L_s$-like productions of loanwords in the study by Jaggers (2018) (see above). Babel (2016) describes the conditions under which speakers of a variety of Bolivian Spanish maintain $L_s$-

faithful laryngealized (aspirated and ejective) consonants in loanwords from Quechua. Notably, conversations concerning topics for which loanwords are generally most likely to appear, including agriculture, the local landscape, and insults or threats, are also the contexts in which laryngealized consonants are most likely to be realized. While most uses of laryngealized consonants occur within Quechua loanwords, Babel even documents cases where heavy aspiration is realized in Spanish words for expressive or sound-symbolic purposes.

Aziz *et al.* (2023) elicit productions of established loanwords from Indonesian into Acehnese from bilingual speakers highly proficient in $L_S$. They find a tendency for a variety of $L_B$-compatible $L_S$ vowels, especially /i/, /ə/, and /a/, to be adapted as the high back unrounded vowel /ɯ/, which does not occur in $L_S$ and is a salient characteristic of $L_B$. Aziz *et al.* propose that this adaptation pattern is used to express Acehnese identity by making the loanwords sound more like $L_B$ words. This phenomenon, involving changes to an $L_S$ structure that would already have been legal in $L_B$, can be called *overadaptation*.

In general, since overadaptation involves changes to $L_B$-compatible structures, it is not likely to be caused either by $L_B$ speakers' perception of $L_S$ forms, or by the $L_B$ non-loan phonological grammar. We might therefore expect cases of overadaptation to be related to social factors — such as the expression of $L_B$ speakers' identity, as argued by Aziz *et al.* (2023) for Acehnese, or community-wide social conventions for loanword phonology, which are addressed in the following section.

### *3.3.3 Social conventions for loanword phonology*

Once a community has adapted a number of loanwords, the possibility emerges for the development of a set of conventions for how loanwords, perhaps from a specific source language, are to be adapted.

Shinohara *et al.* (2011) compare the results of perception experiments with patterns of loanword adaptation in Korean from the source languages Japanese, English, and French. They find a number of cases where the loanword adaptation patterns are systematic, but nevertheless diverge from the actual perception results, and argue that the loanword patterns show effects of social conventions, including official prescriptive standards, for loanwords; a similar argument is made by De Jong & Cho (2012), who compare the results of an experiment on the perception of English stimuli by Korean listeners with a corpus of established loanwords from English into Korean, and conclude that some of the differences are explained by an “explicit sociocultural standard.” Duběda (2014) argues that consonants, and to some extent vowels, in Czech loanwords from French are

mapped to Czech phonological categories in a "mechanical," conventionalized way, referring to this system as a "shadow phonology" of French represented by speakers of Czech. Chang (2020) identifies effects of prescriptive considerations in lexical tone assignment for loanwords from English into Mandarin. General models of loanword adaptation by speech communities rather than by individual speakers, which explicitly account for effects of conventionalization, are proposed by Crawford (2009) and Uffmann (2013). See also Poplack (2018: chapter 10) on social factors in aspects of borrowing behavior beyond phonology.

### *3.3.4 Summary: Effects of social factors and social context on loanword phonology*

On the one hand, lower $L_s$ proficiency on the part of $L_b$ speakers often correlates with a greater reliance on perception-based patterns in loanword adaptation. This is intuitively plausible: speakers who know little of $L_s$ might be expected to rely more on what they can hear, rather than on abstract categories that are meaningful in the context of the $L_s$ grammar.

Other social factors discussed here, including attitudes toward $L_s$ or toward linguistic and cultural contact in general, as well as the indexation of identity, appear mainly to be predictors of the degree to which loanwords undergo adaptation (nativization) versus importation (preservation of $L_s$-like structures). That said, Jaggers & Baese-Berk (2020) find that attitudes toward linguistic contact can also influence the interpretation of acoustic cues in loanword adaptation. It will be interesting to see whether future studies uncover further examples in which speaker attitudes influence adaptation strategies beyond the question of adaptation versus importation.

## 4. Implications of loanwords for phonological theory

As we have seen, factors beyond phonology, especially phonetic, orthographic, and social factors, also influence the phonological shape of loanwords (section 3). Thus, loanword patterns are not necessarily a direct window into the $L_b$ phonological grammar (see also de Lacy 2009). Much recent and current work in loanword phonology seeks to disentangle the effects of these various influences, both to understand each better in its own right, but also to clarify how and when evidence from loanwords can legitimately be invoked in phonological argumentation. Loanword data still has the potential to serve as external evidence for claims about the $L_b$ phonological grammar specifically, and about the nature of the phonological component of human language more generally.

## 4.1. Methodologies

Current work on the phonology of loanwords and its implications often involves experimental, corpus, and/or quantitative methods, in addition to formal phonological analysis.

*Nonce-loanword nativization experiments*, in which participants "borrow" $L_S$-like nonwords, remove the potential confound of $L_B$ speakers' knowledge of established loans and directly examine how they adapt loans that they have never encountered before. This methodology has the advantage of showing what nativization patterns are productive for, or preferred by, $L_B$ speakers. Unless the stimuli are explicitly designed to do so, however, these experiments may not distinguish among the effects of the many phonological and non-phonological factors that can influence loanword adaptation.

*Perception experiments* can be used to compare $L_B$ speakers' perception of $L_S$ stimuli with patterns observed in loanword adaptation or established loanwords. This methodology does not ask $L_B$ speakers to nativize an $L_S$ form, but rather probes what they hear when they encounter structures from $L_S$. This approach can be used to identify patterns in loanword phonology that do, or do not, conform to perceptual illusion effects for the same language (section 3.1.2).

In a sense, almost all research on established loanwords is a type of *corpus study*; there is a long tradition of drawing generalizations from lists of loanwords, whether collected from dictionaries, elicited from $L_B$ speakers, or observed naturalistically. Recent years have seen an increase in studies using larger-scale corpora, more sophisticated statistical analysis methods, or a combination of the two. The goals of such studies often include the documentation of trends or patterns that may previously have been described only impressionistically or anecdotally, as well as the identification of new generalizations about loanwords or adaptation processes — including *gradient* trends or tendencies that were not examined, or perhaps not even observed, in earlier work.

It is important to keep in mind that different experiment methodologies have been shown to amplify different factors, such as phonetic factors versus phonological representations, or gradient versus categorical judgments (Paradis & LaCharité 2011; Kawahara 2013).

## 4.2 External evidence for aspects of the $L_B$ phonological grammar

Recent research continuing to apply loanword data as evidence for *phonological productivity* includes Sano (2012), who computes statistics over a corpus of Japanese spontaneous speech to examine the production of (imported) geminate voiced obstruents in loanwords, arguing that

certain $L_b$ restrictions on these geminates are productive enough to be gradiently active even in loanwords. Similarly, Kawahara (2012), using data from loanword and nonce-word judgment tasks, finds gradient effects in loanwords of a phonological restriction that holds categorically only in non-loans in Japanese: Lyman's Law, a prohibition on multiple voiced obstruents in the same morpheme. Traoré & Féry (2019) use adaptation patterns from loanwords in the Frò?ò dialect of Tagbana to demonstrate the productivity of a set of morphophonological processes affecting syllable structure, which provides support for claims they make about the set of possible shapes for underlying representations of non-loan morphemes in the language. Other examples include AlShammari & AlShammari (2020), on Arabic loanwords in Turkish, and Abdallah (2021), on English, Hausa, and Arabic loanwords in Dagbani.

*Emergence-of-the-unmarked effects* (McCarthy & Prince 1994) are found in loanwords (Paradis 1995) when patterns or defaults that are not observed in the non-loan grammar become evident in adaptation patterns or loanword-specific generalizations. Adell (2013) describes a process of gradient vowel devoicing that occurs in Kaqchikel only in Spanish loanwords, but conforms to typological generalizations about vowel devoicing despite its limited domain of application. Cohen (2013) finds evidence for emergent effects of vowel harmony in loanwords in Modern Hebrew — and further predicts, given the OT postulate of universal constraints, that such emergent vowel harmony should be a cross-linguistic effect. Other examples include Guba (2016, 2021), who identifies emergent effects in segmental and prosodic properties of English loanwords in Ammani Arabic, and Radomski (2019), who argues that the preservation of contrasts between words with the Polish voiceless affricates [tʂ] (postalveolar) and [tɕ] (prepalatal) in English is an emergent effect of the faithfulness constraint IDENT-IO[±distributed].

In many cases, claims about the $L_b$ phonological grammar that are based on facts from loanword adaptation depend on the adaptation patterns being phonological operations, rather than misperceptions or perceptual illusions (section 3.1). An interesting exception is Song (2022), who applies data *from* perceptual illusion effects in loanword adaptation in North Kyungsang Korean to argue that the identity of the vowel involved in perceptual epenthesis depends on the phonological vowel inventory of the language.

### 4.3 External evidence for approaches to phonological analysis

Loanwords continue to be used as evidence for particular *theoretical approaches* to phonological analysis. For example, Oh (2012) argues that morphologically complex loanwords from English in Korean provide support for a Lexical Conservatism effect in morphological alternations (Steriade

2000). Davis & Rahgeb (2014) use evidence from final-stress words borrowed from English and French into Cairene Arabic as part of a more general argument concerning the phonology of geminates, supporting a moraic representation (Hayes 1989) over a skeletal-slot representation (Leben 1980). Becker & Jurgec (2017) argue that the same markedness constraint against high tone on lax mid vowels that drives a tone alternation in the non-loan phonology of Slovenian also drives a vowel quality alternation in loanwords, noting that loanword evidence for this proposed tone/vowel co-occurrence constraint is valuable support because phonological interactions between tone and vowel quality are typologically uncommon. Alhoody (2019) uses evidence from the adaptation of English loanwords into Qassimi Arabic to support a particular analysis of contrastive versus redundant features in L*b*, implementing Contrastive Hierarchy Theory (Dresher 2009).

### 4.4 Lexical strata and their theoretical implications

To the extent that *lexical strata* are synchronically productive for L*b* speakers, the phonological grammar of L*b* has to be able to specify different phonologies for different strata (sections 2.2, 2.3). Complicating matters further, lexical strata often reflect a "hierarchy of foreignness" (Kiparsky 1968; see also Holden 1976; J. Ito & Mester 1995, 1999), in which certain L*s* structures are more frequently nativized than others. J. Ito & Mester (1999) enforce such nativization hierarchies in their OT indexed-faithfulness model with a metaconstraint that specifies a consistent faithfulness ranking across strata. Recent work in Harmonic Grammar (HG; Legendre *et al.* 1990), where constraints are weighted rather than ranked, has aimed to derive nativization hierarchies from basic principles of the model: Hsu & Jesney (2017, 2018) develop an HG version of stratum-specific rankings with *scalar weights* that represent the degree of "foreignness" for each lexeme and algorithmically adjust constraint domination relations accordingly. Smith (2018) makes use of HG's *cumulative constraint interaction,* allow general and stratum-specific constraints to generate a consistent faithfulness ranking across strata by default.

An alternative approach to grammars with phonologically distinct lexical subsets has been developed by Becker & Gouskova (2016). In their model, forms are assigned to distinct lexical subclasses by *gatekeeper grammars* before their outputs are determined by a (possibly subclass-specific) *grammar proper*.

The synchronic productivity of lexical strata is itself an empirical question (Rice 2006), which has been tested experimentally by Pinta (2013) for Guarani, by Smith & Tashiro (2019) for Japanese, and by Pons-Moll & Torres-Tamarit (2021) for Catalan. These studies demonstrate that at least some

stratum-specific patterns and nativization hierarchies are productive, although the results are complex. Meanwhile, the formal learnability of lexical strata has been computationally confirmed by Morita & O'Donnell (2022) for Japanese. Further data on productivity and formal learnability for lexical strata in additional languages would be welcome.

## 5. Conclusions

In addition to the phonological grammar of $L_b$, the phonological shape of loanwords can be affected by a number of factors, including phonetic similarity, perceptual illusions, orthography, and the social characteristics and attitudes of $L_b$ speakers. Nevertheless, when the influence of these factors is controlled for, patterns in loanword phonology can serve as external evidence for the $L_b$ grammar or for phonological models more generally. Moreover, precisely because there are so many different factors at play, loanwords can be a fruitful testing ground for models of phonological interfaces.

Recent years have seen an increase in experimental, computational, and statistical approaches to loanword phonology. Loanword data from additional languages, and studies investigating new and familiar data with more sophisticated methodologies, continue to refine our understanding of possible patterns in loanword phonology and their implications for phonological theory.

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