67 Vowel Epenthesis

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1 Introduction

The term "vowel epenthesis" can refer to any process in which a vowel is added to an utterance. Beyond this simple description, however, vowel epenthesis processes vary enormously in their characteristics, and many aspects of their typology are still not well understood. Accordingly, the empirical focus of this chapter is on the heterogeneity of vowel epenthesis processes.

   This chapter is organized around several empirical questions, namely: What is the function or cause of vowel epenthesis (§2)? What determines the location (§3) and quality (§4) of an epenthetic vowel? Do epenthetic vowels differ phonetically or psycholinguistically from lexical vowels (§5)? What distinguishes an excrescent vowel (§6)? How does vowel epenthesis interact with other phonological processes (§7)? Finally, §8 reviews research on epenthetic vowels in loanwords, and revisits some of the previous questions to discuss how the answers may differ in the case of loanwords.

   Throughout this chapter, epenthetic vowels are underlined for visual clarity.

2 What is the function/cause of vowel epenthesis?

In most cases, the function of vowel epenthesis is to repair an input that does not meet a language's structural requirements. In particular, vowel epenthesis allows the surfacing of consonants that underlyingly appear in phonotactically illegal contexts. For example, Lebanese Arabic epenthesizes vowels into many CC codas to break up undesirable coda clusters. Epenthesis is more or less obligatory in coda clusters of an obstruent followed by a sonorant, as in (1a), and optional in most other clusters as in (1b) (see Haddad 1984a for a detailed breakdown of coda types).

(1) *Epenthesis in Lebanese Arabic* (Abdul-Karim 1980: 32–33)

    a. /ʔism/   ʔis<u>i</u>m 'name'   b. /kibʃ/   kibʃ ~ kib<u>i</u>ʃ 'ram'
         /ʔibn/   ʔib<u>i</u>n 'son'   /sabt/   sabt ~ sab<u>i</u>t 'Saturday'
         /ʃiɣl/   ʃiɣ<u>i</u>l 'work'   /nafs/   nafs ~ naf<u>i</u>s 'self'

There is controversy over exactly how to analyze the phonotactic requirements that motivate epenthesis. Probably the most popular approach is to assume that epenthesis allows the syllabification of stray consonants (Itô 1989), but Broselow (1982) explores the idea that some epenthesis is simply triggered by particular sequences of consonants, irrespective of syllable structure requirements. Côté (2000) argues that epenthesis is motivated primarily by the need to make consonants perceptible, based on the Licensing by Cue approach of Steriade (1994). For example, one of the main cues that listeners rely on to identify place features of consonants is the formant transitions on neighboring vowels. Hence, a consonant that is not adjacent to a vowel is less easy to identify (see CHAPTER 46: POSITIONAL EFFECTS IN CONSONANT CLUSTERS).

In a case like Lebanese, it might be argued that claiming a structural motivation for vowel epenthesis is circular, given that this optional vowel epenthesis is the only evidence that such clusters are marked in this language. But in some languages, vowel epenthesis is only one of a "conspiracy" of processes removing a particular cluster type. In Welsh, for example, codas with rising sonority are repaired through deletion, as in (2a), lenition (2b), metathesis (2c), or vowel epenthesis (2d), while codas with falling sonority are left intact.

(2) *Welsh repair of obstruent–sonorant codas* (Awbery 1984)

    a. /fenestr/ → feːnest 'window' (southern dialect)
    b. kevn   > kɛwn   'back' (Pembrokeshire dialect)
    c. sɔvl   > sɔlv   'stubble' (north-east dialect)
    d. /kevn/   → keːven 'back' (southern dialect)

The fact that all four processes target the same cluster type supports the idea that this cluster type is marked, and that vowel epenthesis is one of the repairs for the marked structure.

A second common reason for epenthesis is to bring a word up to a certain minimal size. Some languages require each lexical word to have a minimum of two moras or two syllables. Often, roots of smaller size are augmented with an epenthetic vowel, as shown in (3a) for Mono (Banda, spoken in Congo). The epenthetic vowels do not appear when the same roots appear in longer compounds, as in (3b).

(3) *Mono vowel epenthesis* (Olson 2003)

    a. /ʒī/   → īʒī   'tooth'
        /bè/   → èbè   'liver'
        /mà/   → àmà   'mouth'
        /ndà/   → àndà   'house'
    b. /mà+ndà/ → màndà 'door'   *àmààndà

Metrical structure above the word level can also affect epenthesis. In Galician, vowels are optionally added at the end of an intonational phrase (Martínez-Gil 1997). This is illustrated in (4), where the word *pan* 'bread' can be pronounced with final [i] only if it directly precedes a prosodic break (a–c), not within an intonational phrase (d).

(4) *Epenthesis at intonational phrase boundaries in Galician* (Martínez-Gil 1997)

    a. *Ela vai trael-o pan (~ pan[i̱]).*
       'She's going to bring the bread.'
    b. *O pan (~ pan[i̱]), fixo-no onte.*
       '(As for) the bread, (s)he made it yesterday.'
    c. *Dille que traia pan (~ pan[i̱]), non viño.*
       'Tell him/her to bring bread, not wine.'
    d. *Ela vai trae-lo pan (*pan[i̱]) que comprou.*
       'She's going to bring the bread that she bought.'

This epenthesis occurs only with words whose final syllable is stressed: words like ['bo] 'good' and [ka.'fɛ] 'coffee' have the variants ['bo.i̱] and [ka.'fɛ.i], but words with non-final stress like ['la.pis] 'pencil' cannot be pronounced *['la.pis.i̱]. Martínez-Gil proposes that the function of this epenthesis is to create a well-formed bimoraic trochee at the edge of each intonational phrase. A similar pattern occurs with optional [ə]-insertion in Parisian French (Fagyal 2000).

    A different aspect of phrasal metrical structure affects epenthesis in Dutch. As shown in (5), Dutch has optional schwa epenthesis in coda clusters that consist of a liquid followed by a non-coronal consonant, as well as coda /rn/.

(5) *Dutch [ə]-epenthesis* (Booij 1995)

    tʏlə̱p ~ tʏlp   'tulip'
    hɛlə̱p ~ hɛlp   'help'
    hɛrə̱fst ~ hɛrfst 'autumn'
    kɑlə̱m ~ kɑlm   'quiet'

Kuijpers and van Donselaar (1997) find that speakers are more likely to insert the schwa if this will create a rhythmic alternation of stressed and unstressed vowels. Epenthesizing a schwa in /tʏlp/ changes the word from a single stressed syllable ('σ) to a stressed–unstressed sequence ('σσ) (see also CHAPTER 40: THE FOOT). This happens significantly more often when the first syllable of the following word is stressed than when it is unstressed, as shown in (6).

(6) *Effects of sentence rhythm on epenthesis in monosyllabic words*

context	[ə]-epenthesis	
σσ __ 'σ	50%	['tʏlp] and ['tʏlə̱p] equally preferred
'σσ __ σ	35%	['tʏlp] preferred over ['tʏlə̱p]

Metrical structure above the word level only has gradient effects on vowel epenthesis; there do not seem to be cases of obligatory vowel epenthesis for rhythmic purposes, aside from the minimal word requirement discussed above. Perhaps this is because phrase-level metrical structures themselves tend to show much optionality.

    While most analyses of vowel epenthesis focus on structural motivations, there is a little research examining the effects of epenthesis on perception. Van Donselaar *et al.* (1999) bring evidence that vowel epenthesis in Dutch enhances the perceptibility of the consonants adjacent to the epenthetic vowel, particularly the preceding liquid. In lexical decision and phoneme identification tasks, subjects

react faster to forms with epenthesis, like [tʏlə̯p], than to forms without epenthesis, like [tʏlp], even though the form without epenthesis is more canonical and closer to the spelling. The authors suggest that speakers epenthesize the vowels to help the listener.

Finally, there are some cases where epenthetic vowels (or, at least, vowels widely described as epenthetic) have no apparent function in terms of phonotactics, metrics, or any other structural requirements. This is seen in Scots Gaelic, where epenthetic copy vowels historically arose in sonorant–obstruent coda clusters following short stressed vowels, as in (7). These vowels are widely analyzed as being still epenthetic today. As discussed further in §5, these vowels are phonetically marked by a special pitch and duration pattern, and they have a number of distinguishing phonological characteristics. Speakers are reported to consider these VRVC sequences monosyllabic, in contrast to other VRVC sequences.

(7) *Scots Gaelic* (Borgstrøm 1937, 1940; Oftedal 1956)

    ʃalа̱k   'hunting'
    kʰɛnʸʲε̱p 'hemp'

Interestingly, there are many words where one of the consonants that originally triggered the epenthetic vowel has deleted historically, yet the epenthetic vowel has remained – and retained its unique phonetic and phonological characteristics. In the words in (8), the underlined vowel is one that sounds like an epenthetic vowel in terms of pitch and duration, yet synchronically, there is no consonant cluster present to trigger epenthesis. The epenthetic vowel now precedes a word boundary or another vowel, and hence plays no role in terms of improving phonotactics. In fact, it often creates a V.V sequence, which is cross-linguistically dispreferred.

(8) *Unpredictable vowel epenthesis in Scots Gaelic*

    marа̱.i   *marbhaidh*   'will kill'
    dɯrʲі̱   *duirgh*   'fishing lines'
    ɛnʸʲε̱.i   *aithnichidh* 'will recognize'

There are many possible interpretations of such facts. One theory might be that the triggering consonants are present underlyingly and removed through a separate process; another theory is that vowels originally introduced through epenthesis have been reanalyzed as something else (see Hall 2003 for an argument that all "epenthetic" vowels in Scots Gaelic actually reflect a diphthong-like structure in which a vowel and sonorant are phonologically adjoined, and where their articulations overlap so that the same vowel is heard in two pieces). While cases like Scots Gaelic are unusual, they are a reminder that some vowel epenthesis patterns do not seem to have clear structural motivations.

3 What determines the location of an epenthetic vowel?

When vowel epenthesis is used to break up a consonant cluster, there is often more than one location where the vowel could be placed to produce a phonotactically

acceptable output. For example, if a language has the syllable structure (C)V(C), hence disallowing CC clusters at the beginning of a word, an initial CCV could be broken up by putting a vowel before the consonants (V̠C.CV) or between the consonants (CV̠.CV). In a medial CCC cluster, the vowel could occur before the second or third consonant. The choice of epenthesis locations is language-specific. Arabic dialects, for example, systematically differ in this regard. As shown in (9), "onset" dialects like Egyptian syllabify the second consonant as an onset, meaning that the epenthetic vowel follows the second consonant, while "coda" dialects like Iraqi syllabify the second consonant as a coda, meaning that the epenthetic vowel follows the first consonant (Broselow 1992; Kiparsky 2003; Watson 2007).

(9)   *Treatment of* /CCC/ *in Arabic dialects* (Itô 1989)

Cairene   /ʔul-t-l-u/   ʔul.ti̠.lu   'I said to him'
Iraqi   /gil-t-l-a/   gi.li̠t.la   'I said to him'

Temiar (Mon-Khmer, Malaysia) has a much-studied pattern of epenthetic vowel placement in long consonant clusters. Temiar allows only CV and CVC syllables. Given an onset of three or four consonants, Temiar inserts epenthetic vowels to form a string of open syllables terminated by a closed syllable. The epenthetic vowel is a schwa in open syllables; [e] in closed syllables.

(10)   *Temiar syllabification* (Itô 1989)

/slɔg/   sə̠lɔg   'sleep, marry (ACT PERF)'
/snlɔg/   se̠nlɔg   'sleep, marry (ACT PERF NOMINALIZED)'
/snglɔg/   sə̠ne̠glɔg   'sleep, marry (ACT CONT NOMINALIZED)'

Itô (1989: 241) argues that these patterns of vowel placement can be explained if syllabification is directional. Abstracting away from certain theoretical details, the insight is that languages like Temiar and Iraqi compute maximal syllables starting from the end of the word, while languages like Egyptian compute maximal syllables from the beginning of the word. A stray consonant that could be syllabified more than one way becomes an onset of a following syllable in right-to-left languages, but the coda of a preceding syllable in left-to-right languages, and the placement of the epenthetic vowel varies accordingly.

(11)   *Directionality in syllabification*

Left-to-right syllabification	Right-to-left syllabification	
Cairene	*Iraqi*	*Temiar*
/ʔultlu/	/giltla/	/snglɔg/
ʔul.	.la	.lɔg
ʔul.ti̠.	.li̠t.la	.ne̠g.lɔg
ʔul.ti̠.lu	gi.li̠t.la	sə.ne̠g.lɔg

While directional syllabification works well to explain epenthetic vowel placement in many languages, I will discuss in §8 some cases of loanword adaptation where directional syllabification cannot explain epenthetic vowel placement.

4   What determines the quality of an epenthetic vowel?

The quality of an epenthetic vowel may be determined in one of two ways: it is either a fixed, default quality (which may, of course, be subject to normal allophonic variation according to the language's phonology), or else the quality is determined by some part of the phonological context.

Lebanese Arabic is an example of a language with fixed-quality epenthetic vowels: the epenthetic vowel is always [i]. Different languages have different qualities for their epenthetic vowels, and some qualities are found more commonly than others. Epenthetic [i] and [ə] are especially frequent, but de Lacy (2006: 289) also lists examples of epenthetic [ɨ], [e], and [a]. It is rare for fixed-quality vowels to be [+round], but examples do occur in Quebec French (Martin 1998) and in the Austronesian languages Buol and Kambera (Rice 2008). (There are, of course, also many cases where a basically fixed-quality vowel becomes predictably rounded in some contexts through additional processes such as vowel harmony.)

In "copy vowel epenthesis," the epenthetic vowel must have the same quality as a nearby vowel. In Welsh, for example, final CC clusters are broken with a vowel that is a copy of the preceding vowel. The forms in the left column of (12) illustrate how the epenthetic vowel is absent when a suffix renders the CC cluster non-final.

(12)   *Copy vowel epenthesis in Welsh* (Awbery 1984: 88)

gwadne	gwaːda̱n	'soles, sole'
kɛvne	keːve̱n	'backs, back'
pədri	puːdu̱r	'to rot, rotten'
ɔχri	oːχo̱r	'to side, side'

The direction of copying varies by language; both right-to-left and left-to-right copying are well attested.

In rare cases, the quality may relate to more than one nearby segment. In Scots Gaelic, the quality of the epenthetic vowel depends on both the preceding vowel and the preceding consonant. Sonorants in Scots Gaelic contrast for backness. When epenthesis occurs in a /VRC/ sequence where the vowel and sonorant disagree in backness, the epenthetic vowel shares the backness specification of the sonorant (Clements 1986; Ní Chiosáin 1995; Bosch and de Jong 1998; CHAPTER 75: CONSONANT–VOWEL PLACE FEATURE INTERACTIONS).

(13)   *Incomplete vowel copy in Scots Gaelic* (vowel transcription following Ní Chiosáin 1995)

færa̱k	'anger'
inɨxinʸjə	'brain'
bulʲi̱k	'bellows'
dɨlʲi̱kʲ	'sorry'
mʌrʲe̱v	'dead'

There has been controversy over whether the grammatical mechanisms that allow epenthetic vowels to copy other vowels' quality might be similar to the mechanisms

involved in reduplication (where a morpheme copies its segmental content from other segments in the base word; CHAPTER 100: REDUPLICATION). Kitto and de Lacy (1999) argue for a unified theory of the two processes, in which segments in reduplicants and epenthesized segments both have a "correspondence" relation with another segment elsewhere in the word. Kawahara (2007), however, points out a couple of basic differences between these kinds of copying. First, epenthetic copy vowels always copy a vowel in an adjacent syllable, whereas reduplicants may skip adjacent syllables to copy more distant material. For example, in Nakanai (Oceanic; Johnston 1980), a vowel in a reduplicant copies the most sonorous vowel in the base, regardless of its location. Kawahara finds no cases of epenthetic vowels copying distant vowels in this manner. Secondly, copying in epenthetic vowels (especially in loanwords; see §8) is sometimes blocked when particular kinds of consonants intervene, but blocking effects like this are not found in reduplication, where copying can occur over any type of intervening segment. Kawahara proposes that long-distance, correspondence-based copying is available only for morphological operations like reduplication, and that copying of quality in epenthesis always reflects local feature spreading.

5   Do epenthetic vowels differ phonetically or psycholinguistically from lexical vowels?

5.1   *Phonetic characteristics of epenthetic vowels*

There is evidence that in some languages, epenthetic vowels differ articulatorily and acoustically from lexical vowels, and tests that probe speaker intuitions may also find differences. Since these phonetic or psycholinguistic differences may have implications for phonological questions, I will briefly review the evidence.

As shown in (1), Lebanese Arabic optionally inserts an epenthetic vowel in certain CCC or CC# clusters (/mitl/ → [mit̪il] 'like'). The epenthetic vowel is normally transcribed as [i], but Haddad (1984b: 61) impressionistically notes that "this representation is rather inadequate since an inserted vowel is more prone to suprasegmental features such as 'guttural' and 'emphatic' [pharyngealized] than an underlying vowel is." An acoustic phonetic study by Gouskova and Hall (2009) finds that for some speakers, epenthetic "[i]" is significantly shorter in duration than a lexical [i], and has a lower second formant value. The low F2 indicates that the articulation is relatively back, so that a more appropriate transcription might be [ɨ].

Sometimes the phonetic differences involved in vowel epenthesis are reported to extend over a longer string of the word. The Siouan language Hocank has epenthesis in certain CCV sequences, as in /kre/ → [kere] 'depart returning'. Although no instrumental study has been done, Susman (1943) and Miner (1979) agree that CV̆CV sequences resulting from epenthesis are audibly shorter in duration than lexical CVCV. The duration difference appears to involve not only the epenthetic vowel, but also the lexical vowel next to it.

Another kind of phonetic difference is reported in Scots Gaelic, where, as shown in (7), epenthesis occurs in certain CC sequences following a short stressed vowel (/tarv/ → [tarᵊv] 'bull'). These epenthetic vowels are often *longer* than lexical vowels in the same position (Bosch and de Jong 1997). The pitch of the resulting

CVC<u>V</u>C sequence is distinctive: although a normal CVCVC disyllable has a rise and fall in pitch, Ladefoged *et al.* (1998) show that epenthetic CVC<u>V</u>C has only a pitch rise, confirming Oftedal's (1956) description. Speakers are reported to consider such sequences monosyllabic (Oftedal 1956: 29) or "nearly monosyllabic" (Borgstrøm 1940: 153).

Several studies couched in Articulatory Phonology have offered evidence that epenthetic schwa in English differs articulatorily from lexical schwa (see CHAPTER 26: SCHWA). Davidson and Stone (2003) present an ultrasound study of English speakers pronouncing pseudo-Slavic words that began with consonant clusters that are illegal in English, such as /zgomu/. Subjects frequently inserted an audible epenthetic schwa, producing [zəgomu]. However, when the articulation of schwa was compared to the lexical schwa of similar words like *succumb* [səkʌm], the tongue position differed significantly. Davidson and Stone suggest that the acoustic schwa does not correspond to a distinct articulatory gesture, but is essentially a transitional sound, the result of a low degree of overlap between the articulatory gestures comprising /z/ and /g/. Smorodinsky (2002) uses EMA to study the epenthetic schwas in English inflectional morphology, and reports differences (though not very robust ones) in tongue position between the epenthetic schwa in *cheated* ['ʧirəd] and the lexical schwa in *cheetah'd* ['ʧirəd].

Gick and Wilson (2006) give a related analysis of the schwa that many English speakers insert between a high tense vowel and a liquid, as in *fire* (faɪr ~ faɪ̯ər). They argue that the schwa sound is not an inserted phonological unit, but an incidental result of the tongue passing through a schwa-like configuration as it transitions between the opposing tongue root positions of the high front vowel and the liquid.

As of yet, few examples of epenthetic vowels have been instrumentally studied, so it is not clear whether epenthetic vowels differ phonetically from lexical vowels in every language. There are plenty of cases where epenthetic vowels are impressionistically described as being acoustically identical to lexical vowels (e.g. Mohawk; Michelson 1989: 40, 48). It is also unknown whether the vowels' phonetic nature correlates with any aspect of their phonological behavior (such as whether the vowel is obligatory or optional, or whether the vowel interacts opaquely with processes like stress assignment). This is likely a rich area for future research.

5.2   Speaker intuitions about epenthetic vowels

There are indications that speakers are not always conscious of epenthetic vowels in the same way as lexical vowels. One type of evidence comes from situations where speakers are asked to write their pronunciations phonetically. Pearce (2004: 19) asked speakers of Kera (East Chadic, spoken in Chad, with no tradition of writing) to choose between two possible spellings for acoustically CVC<u>V</u>CV words, where the middle vowel was analyzed as epenthetic. The speakers chose CVCCV spellings, suggesting that the middle vowel was not part of their conscious segmentation of the word. On the other hand, when I have asked Lebanese Arabic speakers to write colloquial pronunciations (which are not usually written, as orthography follows Classical Arabic), they do write in the epenthetic vowels. This suggests that speakers' consciousness of epenthetic vowels may differ from language to language.

Van Donselaar *et al.* (1999) argue that in Dutch, where vowel epenthesis is optional ([tʏlp] ~ [tʏlə̪p]), speakers treat the form without epenthesis as canonical. In an experiment, Dutch speakers were asked to perform different language-game-like reversals on monosyllables and disyllables: subjects were to reverse monosyllables segment by segment, changing [tap] to [pat], and reverse disyllables syllable by syllable, changing [hotɛl] to [tɛlho]. Over 90 percent of words with vowel epenthesis were treated like monosyllables, so that [tʏlə̪p] 'tulip' changed to [plʏt] rather than [lə̪ptʏ]. The authors suggest that speakers have a unitary representation for the forms with and without epenthesis. It might be objected, however, that the experiment is contaminated by orthographic differences between lexical schwa, which is written, and epenthetic schwa, which is not. Another objection, raised by a reviewer, is that [lə̪ptʏ] is not a possible word in Dutch, due to its final lax vowel.

Speakers may be particularly likely to lack awareness of the kind of weak epenthetic vowels often called "excrescent" (discussed further in §6). For example, Harms (1976) reports that Finnish speakers are unaware of an epenthetic schwa that is easily perceived by some non-native speakers:

> [mɛləkein] (*melkein*) 'almost' has essentially the same vowel qualities ([ɛ, ə, ei]) and relative durations as the English verb *delegate* – [dɛləgeit]. From a descriptive phonetic point of view, the Finnish [epenthetic] schwa and the English reduced-vowel schwa represent very nearly identical classes of vowel sounds; i.e., they vary over a wide central area, with their range of variation conditioned by the preceding and following segments. But here the similarity ends. The schwa in the above Finnish forms is purely transitional in nature. Speakers perceive these forms as containing only two syllables, not three.

Few studies of vowel epenthesis have probed the intuitions of native speakers about the vowels, and it would be useful to have data from more languages on how speakers perceive epenthetic vowels, including how the vowels are written, treated in metrics, and treated in language games (see CHAPTER 96: EXPERIMENTAL APPROACHES IN THEORETICAL PHONOLOGY).

6   What distinguishes an "excrescent" vowel?

A number of proposals distinguish a special class of epenthetic vowels often called "excrescent" (Levin 1987) or "intrusive" (Hall 2006). These terms are usually used for vowels that are noticeably phonetically weaker than other vowels. Typically, excrescent vowels are short in duration and centralized in quality. The excrescent vowel may have a quality not present in the language's lexical vowel system; for example, excrescent schwa may exist in a language that otherwise has no schwas. Excrescent vowels are systematically ignored by other phonological processes. The commonly expressed insight is that excrescent vowels are a kind of phonetic effect, likely a transition between consonant articulations.

A classic example of excrescent vowels is the short vowels that occur in consonant clusters in Piro (Arawakan), as shown in (14). Matteson and Pike (1958) note that these vowels differ from the short phonemic vowels of Piro (/i e o a ï/) in several ways. The excrescent vowels are subject to extensive free variation. Their

quality can be highly variable, as in /hwï/ below, where the excrescent vowel has been recorded with five different qualities. Also, in some cases the presence of the excrescent vowel varies with "syllabification" of a consonant, as in /whene/ below. The vowels cannot bear any kind of stress, and they are of much shorter duration than lexical vowels. In terms of timing, the authors report that "in the rhythm of a phrase, a consonant plus the transition vocoid corresponds in timing to a single consonant rather than to a sequence of consonant plus vowel." The excrescent vowels fail to block a pattern of co-articulatory rounding that is blocked by other vowels. In Piro orthography, the excrescent vowels are not written.

(14)   *Excrescent vowels in Piro* (Matteson and Pike 1958)

/kwalï/	kᵊwalï ~ kᵒwalï	'platform'
/tkatʃi/	tᵊkatʃi	'sun'
/ʃjo/	ʃⁱjo	'bat'
/hwï/	hᵊwï ~ hᵒwï ~ hᵊwï ~ hⁱwï ~ hᵘwï	'O.K.'
/whene/	w̥hene ~ wᵊhene ~ wᵒhene ~ wⁱhene ~ wᵘhene	'child'

Based on the vowels' exceptional phonological and phonetic characteristics, the authors analyze them as "non-phonemic transitional vocoids." Vowels with similar characteristics occur in Finnish (Harms 1976), Sanskrit (Allen 1953: 173), South Hamburg German (Jannedy 1994), and other languages listed in Hall (2006).

   Recently, a number of authors have formalized similar ideas about excrescent vowels in an Articulatory Phonology framework. Articulatory Phonology (Browman and Goldstein 1986, 1992) treats abstract articulatory gestures as primitives, and allows the grammar to regulate the timing of articulatory gestures with respect to one another. Vowel-like percepts can be created when two consonant gestures are phased to have a low degree of overlap with one another, leaving a period between the consonant constrictions where the vocal tract is relatively open (Browman and Goldstein 1992). See Gafos (2002) and Hall (2006) for arguments that excrescent vowels lack an independent gesture, and hence are not present as phonological units in the way that lexical vowels (and most epenthetic vowels) are.

7   How does vowel epenthesis interact with other processes?

One of the most interesting characteristics of epenthetic vowels is their tendency to interact opaquely with other phonological processes. It is common for phonological patterns to treat epenthetic vowels as if they were not present. This observation has many theoretical interpretations. Some argue that epenthetic vowels are representationally defective: Piggott (1995), for example, argues that some epenthetic vowels are weightless, lacking a mora. Other approaches handle opaque interactions through rule ordering, with the epenthetic vowels being inserted late in the derivation. Here, I will focus on the empirical issues to be explained, with examples of the kinds of interactions that have been reported.

7.1   Metrical patterns

Syllables whose nuclei are epenthetic vowels frequently fail to count as syllables in patterns such as stress assignment, minimal word requirements, and the conditioning of open syllable lengthening. This section gives an example of epenthesis interacting with each of these processes.

In Lebanese Arabic, a closed penult is stressed when it contains a lexical vowel, as in (15a), but not when it contains an epenthetic vowel, as in (15b) (see also CHAPTER 124: WORD STRESS IN ARABIC).

(15)   *Stress–epenthesis interaction in Lebanese Arabic*

    a.   /fihim-na/   fi.'him.na   'he understood us'
    b.   /fihm-na/   'fi.h<u>i</u>m.na   'our understanding'

In words without a closed penult, stress normally falls on the final syllable if it is superheavy, i.e. CVːC or CVCC, as in (16a), and on the antepenult otherwise, as in (16b). Again, vowel epenthesis disrupts the pattern. If an epenthetic vowel is inserted into a final CC cluster, breaking up what would otherwise be a final superheavy syllable, stress is assigned to the penult, as in (16c). This is the only case in which a light penult can be stressed.

(16)   *Lebanese Arabic* (Haddad 1984a)

    a.   /nazzal-t/   naz.'zalt   'I brought down'
    b.   /katab-it/   'ka.ta.bit   'she wrote'
    c.   /katab-t/   ka.'ta.b<u>i</u>t   'I wrote'

For all of the patterns above, stress is simply assigned as if the epenthetic vowel were absent. The only exception to this generalization is an epenthetic vowel inserted in an underlying CCCC sequence. In this case alone, the epenthetic vowel is treated the same as a lexical vowel for stress. In (17), the epenthetic vowel falls in a closed penult, and is stressed, as is normal for a heavy penult (cf. (15a)).

(17)   /katab-t-l-ha/   ka.tab.'t<u>i</u>l.ha   'I wrote to her'

Such patterns, where epenthetic vowels are visible to stress under some circumstances but invisible in others, also occur in Mohawk (Michelson 1989) and Selayarese (Broselow 1999).

In languages that require words to have a minimal size, epenthetic vowels may not count in determining this size. Mohawk, for example, requires each lexical word to contain two syllables, as in (18a). A verbal stem containing only one syllable is augmented with an epenthetic [i], as in (18b). Mohawk also inserts an epenthetic [e] after the first consonant of certain CC and CCC clusters. This [e] counts for metrical purposes if it is in a closed syllable, but not if it is in an open syllable. Hence, a two-syllable word containing an open epenthetic syllable, as in (18c), is augmented with epenthetic [i] as well. However, a two-syllable word containing epenthetic [e] in a closed syllable is not augmented, as seen in (18d).

(18)   *Minimal word augmentation in Mohawk* (Michelson 1989)

    a.   /k-hninu-s/   'khniː.nus   'I buy'
    b.   /k-jʌ-s/   'i̱k.jʌs   'I put it'
    c.   /s-riht/   'i̱.se̱.riht   'cook!'
    d.   /s-rho-s/   'se̱r.hos   'you coat it with something'

This interaction highlights another interesting problem: the fact that there may be multiple vowel epenthesis processes in a single language, which differ in whether they are metrically "visible."

    Epenthetic [e] in Mohawk also shows another type of metrical invisibility: it fails to trigger a rule by which stressed vowels lengthen in an open syllable. In (19a) we see this rule apply normally. In (19b), it appears that the stressed [i] is an open syllable, since the following epenthetic vowel has syllabified [r] as an onset; yet the stressed syllable fails to lengthen.

(19)   *Stressed vowel lengthening in Mohawk*

    a.   /wak-ashet-u/   wa.kas.'heː.tu   'I have counted it'
    b.   /s-riht/   'i̱.se̱.riht   'cook!'

    In sum, although epenthetic vowels are usually added in order to syllabify stray consonants, the syllables they form do not necessarily count as syllables for other aspects of the phonology.

7.2   Segmental processes

In some cases, epenthetic vowels fail to condition other segmental processes, such as deletion or allophonic variation, in the same way that lexical vowels condition them. In Dutch, for example, underlying /ən/ is optionally reduced to [ə], as in (20a). Yet when schwa epenthesis occurs before /n/, as in (20b), the epenthetic schwa does not condition deletion of the following [n]. Some speakers thus eliminate underlying /ən/, yet create surface [ən] through epenthesis.

(20)   *Dutch* [n]-*deletion* (Booij 1995; Hall 2006)

    a.   *regen*   /reɣən/   →   reɣən ~ reɣə   'rain'
        horen   /horən/   →   horən ~ horə   'to hear'
    b.   *hoorn*   /horn/   →   horn ~ hor̩ən *hor̩ə   'horn'

    Similarly, Herzallah (1990) describes a Palestinian Arabic dialect in which a pharyngealized [rˤ] loses its pharyngealization before lexical [i], but not before epenthetic [i] (CHAPTER 25: PHARYNGEALS).

    Just as different epenthetic vowels within a single language may show different metrical behavior, they may also differ in whether they condition other segmental processes. For example, in Tiberian Hebrew, one kind of epenthetic vowel does condition spirantization in following stops, and another does not. Normally a stop becomes a fricative after vowels, as in (21a). One type of epenthetic vowel, which splits up final CC clusters in non-derived words, also causes spirantization. In (21b), we see /b/ spirantize to [β] following the epenthetic [e]. But another epenthetic

vowel, which occurs in final clusters of a guttural and a following consonant, does not condition spirantization. In (21c), the /t/ following the epenthetic vowel is realized as [t] rather than [θ].

(21)   *Tiberian Hebrew spirantization* (McCarthy 1979)

    a.   /katab+t/   →   kaθaβt   'you (FEM SG) wrote'
    b.   /kelb/   →   ke̲leβ̲   'dog'
    c.   /ʃalaħ+t/   →   ʃalaħ̲a̲t   'you (FEM SG) sent'

Thus, there is variation both within and between languages in how vowel epenthesis interacts with other processes.

8   How does epenthesis happen in loanwords?

Typological studies of vowel epenthesis frequently consider loanword data side by side with cases of epenthesis within languages, under the assumption that similar phonological mechanisms produce both (e.g. Broselow 1982; Kitto and de Lacy 1999; among many others). Since vowel epenthesis is particularly common in loanwords, loanword data have played a large role in theorizing on epenthesis, probably more than most other phenomena. However, I would like to argue that conflating loanword and native-language epenthesis is a serious methodological mistake. A growing body of evidence suggests that epenthesis in loanwords differs from epenthesis within languages in its formal characteristics, and may have different causes and functions. For this reason, facts about loanword epenthesis are reviewed here separately from within-language epenthesis, to highlight some likely empirical differences between the two kinds of epenthesis. I will also include some references to epenthesis in "interlanguage," which is the language produced by second language learners. While interlanguage and loanwords are not the same thing, they are related in the sense of both involving language contact, and many loanwords may arise historically from interlanguage forms (see also CHAPTER 95: LOANWORD PHONOLOGY).

8.1   Perceptual origin?

There is considerable debate over whether epenthesis in loanwords happens through perceptual errors by speakers of the borrowing language. Traditionally, it was assumed that a speaker of the borrowing language (likely a bilingual) would hear a foreign word, construct some reasonably accurate representation of the way the word was pronounced in the foreign language, and then alter that representation to fit the phonotactics of the borrower's native language. But Peperkamp and Dupoux (2002) argue that the borrower is likely to perceive the foreign word incorrectly, and that these perceptual errors are the main source of phonological alterations in loanwords (see also CHAPTER 98: SPEECH PERCEPTION AND PHONOLOGY and CHAPTER 95: LOANWORD PHONOLOGY for further discussion).

One piece of evidence for this view comes from Japanese, which inserts an epenthetic vowel to remove illegal codas in loanwords (only a nasal or the first half of a geminate can be a coda). The epenthetic vowel is [o] after [d] and [t], and [ɯ] elsewhere.

(22)   *Japanese loanwords from English* (Itô and Mester 1995)

faito̱   'fight'
fesɯ̱tibarɯ̱   'festival'
sɯ̱fiŋkɯ̱sɯ̱   'sphinx'

Dupoux *et al.* (1999) argue that Japanese speakers actually believe they hear this [ɯ] in the pronunciation of foreign CC clusters. In a perception experiment, Japanese and French listeners were asked to judge whether a middle vowel was present in nonsense words like [ebzo] and [ebɯzo]. For words like [ebzo], where no middle vowel was acoustically present, most Japanese listeners reported hearing a vowel, while most French listeners did not. Japanese listeners also had great difficulty in discriminating between tokens like [ebzo] and [ebɯzo] in an ABX discrimination test. Dupoux *et al.* point out that Japanese [ɯ] is frequently devoiced and shortened, and shows considerable allophonic variation. Knowing this may make listeners likely to fill in an illusory [ɯ] when they hear consonants with no vowel between them.

The idea that epenthesis in loanwords has a perceptual origin is controversial; see Rose and Demuth (2006), Smith (2006), and Uffmann (2007) for arguments that perceptual factors cannot account for all facets of loanword adaptation. Nevertheless, we will see below several additional arguments that perceptual factors play a special role in loanword vowel epenthesis.

8.2   *Function of vowel epenthesis*

For within-language phonology, epenthesis usually occurs to repair an input that does not meet the language's phonotactic or metrical requirements. In most cases, epenthesis in loanwords can be analyzed as having the same function, like the Japanese examples in (22). Yet surprisingly, there is at least one case where speakers add epenthetic vowels to loanwords that were phonotactically permissible in the borrowing language without the vowel. Korean (Kang 2003) frequently epenthesizes a final vowel after English loanwords ending in a stop, as in the examples below.

(23)   *English loanwords in Korean* (Kang 2003: 223)

gag   →   kæki̱
pat   →   pʰæti̱
tube   →   tʰjupi̱

There is no phonotactic need to add vowels to these words. The consonants /k t p/ are among the acceptable codas of Korean, occurring in native words such as [kæk] 'guest', so epenthesis cannot be explained as a means of syllabifying stray consonants. Kang argues that the purpose of the vowel is to maximize perceptual similarity between the English word and the Korean word. English has more release of final stops than Korean does, and Kang claims that to Korean listeners, the release of a final stop of an English word sounds vocalic. She shows that final vowel insertion in loanwords from English is most common in precisely the environments where final stop release is most common in English, such as after voiced stops and

when the preceding vowel is tense. Thus, epenthesis may be a means of preserving phonetic details of the source language, rather than a repair.

8.3   *Relation to native phonology*

The epenthetic vowel used in loanwords often differs from any vowel epenthesis process that exists in the native phonology, and epenthesis may be used in loanwords in contexts where other repairs would be used in the native phonology.

In Japanese, for example, consonant clusters that arise through morpheme concatenation in the native language are repaired through deletion of one of the consonants, as shown in (24). Yet consonant clusters in loanwords are repaired with vowel epenthesis, as in (22).

(24)   *Deletion in Japanese native phonology* (McCawley 1968; Smith 2006)

non-past /-ɾɯ/		*causative* /-sase/		
/jom-ɾɯ/	jo.mɯ	/jom-sase/	jo.ma.se	'read'
/tob-ɾɯ/	to.bɯ	/tob-sase/	to.ba.se	'fly'

Karimi (1987) reports a similar case for Farsi: CCC clusters are subject to consonant deletion in the native phonology, but repaired through epenthesis in loanwords and interlanguage.

In general, vowel epenthesis seems to be a heavily favored repair type in loan adaptation, more than in native phonologies. Uffmann (2007) surveys case studies of loanword adaptation and concludes that consonant deletion is a marginal phenomenon, compared to epenthesis. Paradis and LaCharité (1997) invoke the "Preservation Principle," which states that segmental material is maximally preserved (see also CHAPTER 76: STRUCTURE PRESERVATION: THE RESILIENCE OF DISTINCTIVE INFORMATION). Hence, adding extra segments is less undesirable than deleting segments from the source word. It is possible that the prevalence of vowel epenthesis in loanwords is related to its prevalence in interlanguage. Jenkins (2000) observes, based on a corpus of conversations between non-native speakers of English, that more misunderstandings are caused by deletion of consonants than by addition of vowels. If bilinguals are aware of this fact and therefore favor vowel epenthesis in their interlanguage pronunciations, then any loanwords based on these interlanguage forms would also tend to favor vowel epenthesis.

8.4   *Quality*

As in native language phonology, epenthetic vowels in loanwords may have a default quality or copy their quality from nearby consonants or vowels. However, the patterns of vowel quality in loanwords are often strikingly complex in ways that are not common (and perhaps not attested at all) in native language epenthesis.

Consider the patterns of epenthetic vowel place in words borrowed from English or Afrikaans into the southern Bantu language Sotho, as described in Rose and Demuth (2006). This study examines only the front–back dimension of epenthetic vowel place. In word-initial CC clusters, the epenthetic vowel is back when it follows a labial (25a), and front when it follows a coronal (25b). When the initial

C is velar, the epenthetic vowel copies the place of the following vowel, as in (25c). In word-medial or word-final /CC/ clusters, usually the vowel copies its place from the preceding vowel, as in (25d). (A few further sub-patterns are ignored here. Only epenthetic vowels discussed in the text are underlined.)

(25)　*Epenthesis in loanwords in Sotho* (Rose and Demuth 2006)

	source word	borrowed form	
a.	blɪk	bu̠leke	'tin can, dish'
b.	tɾuwn	tɪ̠ronɪ	'throne'
c.	χɑːf	kʰɑ̠rɑfu	'spade'
d.	hibruw	heb̠eru	'Hebrew'

Sotho also shows epenthesis for minimal word purposes within the native vocabulary, but in this case, the epenthetic vowel is always [ɪ], regardless of context. Sotho is not the only case where vowel epenthesis in loanwords follows such a complex pattern; Uffmann (2007) analyzes similarly complicated rules for epenthetic vowel quality in Shona, Sranan, Nyarwanda, and Samoan, each of which shows an interplay between copying the features of consonants, copying the features of vowels, and insertion of default features.

An informal survey of the literature gives the impression that such complex effects of phonological context on vowel quality are more or less confined to loanword epenthesis. Within languages, it is far more common to find epenthetic vowels of default quality, as in Arabic, or relatively simple kinds of copying, such as always copying in one direction, as in the Welsh pattern in (12). An extensive typological comparison of the formal qualities of vowel epenthesis in loanwords and non-loanwords would be a valuable contribution to understanding the difference between them.

Another important difference between loanword and native language epenthesis is that epenthesis in loanwords is often not fully predictable. As we saw in the Korean examples in (23), epenthesis in a given location may be optional, and in languages like Shona and Sotho, "rules" for epenthetic vowel quality in loanwords are not exceptionless. Uffmann (2007: 9–13) argues that loanword epenthesis needs to be studied by looking for statistical patterns in large corpora of loanwords, because incorrect generalizations are easily reached from impressionistic or limited data.

Both the complexity and unpredictability of some loanword epenthesis patterns may indicate that these patterns have not been internalized by speakers as true phonological "rules" – again, an argument for not considering them side by side with language-internal epenthesis.

8.5　*Vowel placement*

The problem of where to place an epenthetic vowel arises in loanword phonology in the same way as in native language phonology: initial CC clusters, or medial CCC clusters, can potentially be split in two ways.

In some cases, epenthesis location in loanwords or interlanguage appears to follow the same placement pattern as the borrowing language shows in its native epenthesis patterns. For example, we saw in (11) that Iraqi and Egyptian Arabic

differ in how they break up word-medial CCC clusters in the native phonology: Iraqi puts the epenthetic vowel after the first consonant, and Egyptian after the second. These dialects differ in exactly the same way in how they epenthesize into CCC clusters in interlanguage phonology, as seen in (26). This pattern can be explained by the same mechanism, directionality of syllabification, that is commonly used to explain vowel placement in the native phonologies of these languages.

(26) *Iraqi* vs. *Egyptian epenthesis in* CCC *clusters* (Broselow 1987)

			Iraqi	Egyptian
native language	/kitab+t+l+V/	→	ki.ta.bi̱t.la	ki.tab.ti̱.lu
interlanguage	*children*	→	*chili̱dren*	*childi̱ren*

Yet in other cases the placement of the epenthetic vowel is not explainable as a transfer of native language epenthesis rules, and cannot be analyzed through directional syllabification alone. Fleischhacker (2001) presents a typological study of epenthesis in initial CC(C) clusters in loanwords and interlanguage, focusing on the question of whether the vowel precedes the cluster (V̱CC) or breaks up the cluster (CV̱C). She shows that in many languages, the placement of the vowel depends on what kind of consonants are in the cluster, as in the Egyptian Arabic examples in (27). In word-initial clusters consisting of a voiceless sibilant plus a stop, it is cross-linguistically more common to insert a vowel before the first consonant, as in (27a), while in word-initial clusters of an obstruent and sonorant, it is more common to place the vowel between the consonants, as in (27b).

(27) *Egyptian Arabic epenthesis in interlanguage* (Broselow 1987)

a. *study*   → i̱stadi
    special → i̱zbasjal
    ski   → i̱ski
b. *sweater* → si̱wetar
    slide   → si̱laid

Fleischhacker argues that the reason for this pattern is that epenthetic vowels are inserted where they will cause the least perceptual difference between the foreign word and the epenthesized adaptation (a theory which follows the P-map hypothesis of Steriade 2003). She presents an experiment in which English listeners were asked to judge auditory similarity between English words and modifications of those words with epenthetic vowels in different locations. Words beginning with sibilant–stop clusters, like *spar*, were judged more similar to versions with epenthesis before the cluster ([əspɑr]) than to versions with epenthesis within the cluster ([səpɑr]). Words beginning with obstruent–sonorant clusters, like *flit*, were judged more similar to versions with epenthesis within the cluster ([fəlɪt]) than to versions with epenthesis before the cluster ([əflɪt]). The results of the perception experiment thus match the cross-linguistic tendencies in epenthetic vowel placement, and add to the body of arguments that perceptual factors have a special role in loanword epenthesis.

9 Conclusion and suggested directions for future research

In the discussion above, I have tried to highlight some of the main empirical questions about vowel epenthesis, and to show that vowel epenthesis processes are greatly heterogeneous. A better understanding of vowel epenthesis will require work on two dimensions. One is detailed case studies of individual languages, in particular studies that combine the traditional, structural description of vowel epenthesis with attention to the acoustics, articulation, and perception of the epenthetic vowels, and also probe speaker intuitions about the vowels. Epenthetic vowels in Dutch are probably currently the best-studied in this regard, and it would be useful to have similar experiments done with epenthetic vowels in other languages. It would be interesting to examine whether the phonetic nature of an epenthetic vowel (for example, whether it is acoustically identical to a lexical vowel) correlates with any aspect of its phonological behavior (for example, whether it is visible to other phonological processes in the same way that lexical vowels are). The second area is typological work that looks for correlations between different characteristics of epenthetic vowels. Often, typological studies that focus on one variable, such as vowel quality, have lumped together vowel epenthesis processes that differ on other important parameters, such as whether the epenthesis occurs in native words or loanwords, whether the vowels are excrescent or not, whether they are morphologically conditioned, etc. However, it is possible that there may be relations between these variables. For example, it would be interesting to see more systematic comparisons of epenthesis in loanwords *vs.* native phonology, given the growing evidence that these processes may work differently.

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