Chapter 1

Between natural and unnatural phonology: The case of cluster-splitting epenthesis

Juliette Blevins

The Graduate Center, CUNY

A widely recognized feature of loan-word phonology is the resolution of clusters by vowel epenthesis. When a language lacking word-initial clusters borrows words from a language with initial #TRV sequences, T an oral stop and R a liquid, it is common to find vowel epenthesis, most typically vowel-copy, as in, for example: Basque <g**u**rutze> 'cross' from Latin <cruce(m)>; Q'eqchi' <k**u**rus> 'cross' from Spanish <cruz> 'cross', or Fijian <k**o**losi> 'cross' from English <cross>. The phonological rule or sound change responsible for this pattern is sometimes called "cluster-splitting epenthesis": #TRV$_{\mathrm{i}}$ > #TV$_{\mathrm{(i)}}$RV$_{\mathrm{i}}$. The most widely accepted explanation for this pattern is that vowel epenthesis between the oral stop and the following sonorant is due to the vowel-like nature of the TR transition, since #TRV$_{\mathrm{i}}$ is perceptually similar to #TV$_{\mathrm{(i)}}$RV$_{\mathrm{i}}$. A fact not often appreciated, however, is that cluster-splitting epenthesis is extremely rare as a language-internal development. The central premise of this chapter is that #TRV$_{\mathrm{i}}$ in a non-native language is heard or perceived as #TV$_{\mathrm{(i)}}$RV$_{\mathrm{i}}$ when phonotactics of the native language demand TV transitions. Without this cognitive component, cluster-splitting epenthesis is rare and, as argued here, decidedly unnatural.

1 Introduction

Diachronic explanations have been offered for both natural and unnatural sound patterns in human spoken languages. Building on the Neogrammarian tradition, as well as the experimental research program of Ohala (e.g. 1971; 1974; 1993), it is argued that natural sound patterns, like final obstruent devoicing, nasal place assimilation, vowel harmony, consonant lenition, and many others, arise from regular sound changes with clear phonetic bases (Blevins 2004, 2006, 2008, 2015; Anderson 2016). Unnatural sound patterns, in contrast, cannot be explained in terms of simple phonetic processes. Case studies of unnatural patterns show more complex histories: in some cases more than one natural change has been collapsed; in others, a natural change is reanalyzed or inverted;

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in still others, analogy has extended a sound pattern whose origins are morphological, not phonological; and combinations of all of these paths can also be observed (Bach & Harms 1972; Anderson 1981; Buckley 2000; Vaux 2002; Blevins 2008b,a,c; Garrett & Blevins 2009; Anderson 2016).

However, typological study of regular sound change reveals certain kinds of sound change that are neither wholly natural nor wholly unnatural. For example, the shift of *#kl > #tl, documented in at least three different language families, appears to have a natural basis in perception, since [kl] and [tl] clusters are acoustically similar and confused with each other. However, the rarity of this sound change is associated with structural factors: misperception of [kl] as [tl] is strongly associated with the absence of phonological /tl/ clusters in a language. In this case, the absence of a sound pattern, /tl/, influences cognition, making listeners more likely to perceive [kl] as [tl] (Blevins & Grawunder 2009). The presence of a contrast can also facilitate particular types of sound change. As first argued by de Chene & Anderson (1979), compensatory lengthening sound changes are strongly associated with pre-existing vowel length contrasts. This statistical tendency is argued to arise from phonetically natural vowel lengthening in pre-sonorant and open syllable contexts (Kavitskaya 2002), combined with the cognitive effects of structural analogy, where pre-existing categories act as attractors in the course of language acquisition (Blevins 2004: 150–155 and Kavitskaya, this volume).

In this contribution, I offer another example of regular sound change that is neither wholly natural nor wholly unnatural, and highlight the role of human cognition in cases where it has occurred. Cluster-splitting epenthesis is of interest, not only because of its rarity as a regular sound change, but in how it advances our understanding of sound patterns compared to 20th century models (Anderson 1985), and emphasizes the extent to which historical linguists, phonologists, and phoneticians still need the cognitive scientist (Anderson 2001).

2 Cluster-splitting epenthesis in loanword phonology

A widely recognized feature of loanword phonology is the resolution of clusters by vowel epenthesis. When a language lacking word-initial clusters borrows words from a language with initial #TRV sequences, T an oral stop and R a liquid, it is common to find vowel epenthesis, most typically vowel-copy, as illustrated in (1).[1]

If loanword phonology is taken as evidence for properties of phonological grammars (Hyman 1970), a phonological rule describing this pattern can be stated as in (2).

[1] For these and other examples, see: Blevins & Egurtzegi (2016) on Latin loans in Basque; Casparis (1997) on Sanskrit loans in Indonesian; Campbell (2013) on Colonial Spanish loans into Mayan languages; and Kenstowicz (2007) on Fijian loanword phonology. A reviewer notes that some varieties of Q'eqchi' permit initial /CR/ clusters. Proto-Mayan had only *CVC syllables, and Mayan *kurus* arguably reflects borrowing of Colonial Spanish *cruz* into a language which lacked initial CR clusters.

(1) Cluster-splitting epenthesis in loanword phonology

a.	Source language	Latin	*crucem*	‘cross’
	Target language	Basque	g**u**rutze	‘cross’
b.	Source language	Sanskrit	*klēśa*	‘defilement’
	Target language	Indonesian	k**e**lesa	‘indolent’
c.	Source language	Spanish	*cruz*	‘cross’
	Target language	Q’eqchi’	k**u**rus	‘cross’
d.	Source language	English	*cross*	‘cross’
	Target language	Fijian	k**o**lósi	‘cross’

(2) Cluster-splitting vowel-epenthesis

$$\#\mathrm{TRV_i} \longrightarrow \#\mathrm{TV_{(i)}RV_i}$$

Within the structuralist and generative traditions detailed in Anderson (1985), the locus of explanation for this type of epenthesis lies in phonotactic differences between the source language and the target language. Under this general account, the speaker of the target language hears a word pronounced in the source language, constructs a phonological representation with an initial #TR cluster based on this hearing, but then alters this phonological representation in line with the phonotactics of the speaker’s native language which lacks initial #TR clusters (e.g. Broselow 1987; Itô 1989).

Typological studies of loanword phonology and advances in our understanding of speech perception have given rise to 21st century treatments of these patterns that are more explanatory in accounting not only for a “repair” but for the specific type of sound pattern that results. At present, the most widely accepted explanation for the sound pattern in (2) combines two new findings in speech perception, one related to perceptual similarity, and the other related to perceptual illusions. A first component of the analysis is that vowel-epenthesis between the oral stop and following sonorant is due to the vowel-like nature of the TR transition (Fleischhacker 2001; 2005; Kang 2011; Berent 2013; Broselow 2015). Fleischhacker (2001; 2005) argues that the general pattern is determined by perceptual similarity: initial TR clusters are more perceptually similar to TVR than VTR. An important aspect of her work is the distinction between initial #TR clusters and initial #sT clusters, which rarely show vowel-splitting epenthesis, and defy purely phonotactic accounts. A second component of the analysis relates to specific structural differences between the source and target languages. Under the perceptual account, perception of #TR by native speakers of languages that lack initial #TR is biased: these speakers will tend to hear a vowel between the oral stop and the following liquid, even if no vowel is present. Experimental work supporting the existence of illusionary vowels for Japanese speakers presented with CC clusters was presented in Dupoux et al. (1999), and has been supported by much subsequent work (see Peperkamp & Dupoux

2002; Kang 2003; 2011; Kabak & Idsardi 2007; Davidson & Shaw 2012), including a range of studies showing vowel percepts in TR clusters (Berent 2013, and works cited there).[2]

Given this evidence, one might conclude that the sound pattern described in (2) is both natural and common, having a clear phonetic explanation (Blevins 2004; 2008b; 2015). As a natural, phonetically-based sound pattern one might expect many instances of reconstructed word-initial *TR clusters to be resolved by a sound change parallel to the synchronic rule in (2). A sound change of this kind might be even more common than expected on phonetic grounds due to markedness proposals stating that complex onsets are less preferred than simple onsets (Prince & Smolensky 1993; Kager 1999). As I show below, these expectations are not borne out, suggesting that cognitive bias in the context of novel stimuli plays a central role in cluster-splitting epenthesis.

3 Cluster-splitting epenthesis as regular sound change

Very few well-studied and widely agreed upon proto-languages are reconstructed with initial *TR clusters at the oldest stages. One exception is Proto-Indo-European, reconstructed with *TR clusters as well as other initial cluster types (Fortson 2010: 64–65). Some widely agreed upon Proto-Indo-European reconstructions with initial *TR clusters are shown in (3).

(3) Word-initial *TR in Proto-Indo-European

a. *gras- 'eat'	Cf. Vedic *grásate* 'eats, feeds', Greek *grástis* 'green fodder, grass', Latin *grāmen* (< *gras-men) 'grass, fodder'
b. *prek^{j}- 'ask'	Cf. Vedic *pr̥ccháti* 'asks', Latin *precor* 'I entreat', German *fragen*, Tocharian B *prek-*
c. *trejes 'three'	Cf. Lycian *tri-*, Vedic *tráyas*, Greek *treĩs,* Avestan *θrayō,* Latin *trēs*

The Indo-European language family is relatively large, relatively diversified, and relatively well-studied in comparison with other language families of the world. According to *Ethnologue*, there are approximately 445 living Indo-European languages at present, and linguists agree that the major subgroups of Anatolian, Indo-Iranian, Greek, Italic, Celtic, Armenian, Tocharian, and Balto-Slavic have had long independent developments. If cluster-splitting vowel-epenthesis in (2) has a natural phonetic basis in perceptual similarity as outlined above, then a sound change like (3) might be expected to have occurred numerous times in the Indo-European language family.

(4) Cluster-splitting vowel-epenthesis as sound change

$\#TRV_i > \#TV_{(i)}RV_i$

[2] This approach is not agreed upon by all researchers. See Uffmann (2007) and Hall (2011) for discussion.

However, cluster-splitting vowel epenthesis as a regular sound change is rare in the Indo-European language family. *TR clusters are inherited intact in all of the major subgroups, and sound changes affecting these clusters at later stages of development are of distinct types (e.g. palatalization of *l in Romance *Tl clusters; loss of *p in Celtic).

Indeed, within the entire Indo-European language family, there appears to be only one clear instance of a regular sound change like (3).[3] The sound change in question appears to have occurred in relatively recent times, in the transition from Middle Persian to Modern Persian (aka New Persian, Farsi, Dari, Tajiki), or, perhaps more generally, from Middle to Early New Iranian.[4] While the specific sound change is rarely stated as in (3), it is implied. For example in their chapter on modern Persian and Tajik phonology, Windfuhr & Perry (2009: 427–428) describe the language as having syllable onsets consisting of only a single consonant, and note that "The inherited initial clusters have been resolved by prothetic or epenthetic vowels, either of which could become standardized, e.g. st-: *stār* 'star' > *setāre/sitora*, br: *brādar* 'brother' > *barādar/barodar...*" (Windfuhr & Perry 2009: 428). The epenthesis process described is identical to that schematized in (3), and it is also characteristic in loanword phonology, on which much more has been written (see, e.g. Strain 1968, Karimi 1987). Illustrative examples comparing Middle Persian inherited clusters to Modern Persian #CVC sequences are shown in (5).

(5) One case of cluster-splitting epenthesis in Indo-European: Modern Persian

Middle Persian	Modern Persian	gloss	PIE
a. brādar	barādar	'brother'	$*b^h ré h_2 ter$-
b. griftan	gereftan, giriftan	'grab, take'	$*g^h rebh_2$-
c. draxt	daraxt	'tree'	*drew- 'wood'
d. griy-	geri-	'to cry'	$*g^h reh_2 d$-

A second case of cluster-splitting epenthesis sound change is found in the Siouan-Catawba language family, a small group of languages in North America that includes Crow, Hidatsa, Mandan, Lakota, Dakota, Assiniboine, Yanktonai, Stoney, Sioux Valley, Chiwere (aka Iowa-Missouria-Otoe), Hoocąk (aka Winnebago), Omaha-Ponca, Ponca, Kanza/Kaw, Osage, Quapaw, Biloxi, Ofo, Tutelo, Saponi, Catawba and Woccon. The diachronic process known as Dorsey's Law (Dorsey 1885) is a sound change taking Proto-

[3] Fortson (2010: 302–303) mentions evidence for a sound change similar to cluster-splitting epenthesis in Oscan, an extinct Italic language known from inscriptions from approximately 400 BC - 100 CE, as in *aragetud* 'with money' (cf. Lat. *argentō)* and *sakarater* 'it is consecrated' (cf. Lat. *sacratūr*). However, the *rg cluster continued in *aragetud* was arguably heterosyllabic R.T (as opposed to tautosyllabic TR) and initial TR clusters are continued intact in Oscan as in *trístaa, trííbúm, prúfatted* (op cit.).

[4] In his discussion of East and West Iranian dialectology, Windfuhr (2009: 21) states the reflexes of initial #CC-clusters as showing a distinct areal distribution: "insertion of a short vowel, CVC-, along the Zagros, including the NW tier I from Kurdish, Zazaki to the SW Fars and Larestan dialects, as opposed to initial vowel, VCC-, elsewhere", while in the east, Balochi and most East Iranian languages allow initial clusters.

Siouan *TRV to #TV_iRV_i in Hoocąk (aka Winnebago).[5] Examples from Rankin et al. (2015) are shown in (3).

(6) One case of cluster-splitting epenthesis in Siouan: Dorsey's Law in Hoocąk

Chiwere	Hoocąk	Proto-Mississippi-Valley	gloss
a. églų̃ñį	waki/kųnųnį	*krų́rį	'forget'
b. glé	keré	*kre	'go back to'
c. wa/brú	ru/purú 'plough'	*prú	'powder'

While the time-depth of Siouan-Catawba is thought to be 2,000–3,000 years (Parks & Rankin 2001), Hoocąk and Chiwere are considered to be closely related and even sometimes treated as dialects of a single language (Miner 1979).[6] Given this, Dorsey's Law must be a relatively recent development.

Outside of the Persian and Hoocąk cases, it is difficult to find convincing cases of cluster-splitting epenthesis as a diachronic development. And here lies the central point of interest. Given that cluster-splitting epenthesis is common in loanword phonology (2), and appears to be a natural phonetically-motivated process, why is it rarely attested as a regular sound change? Why, out of more than 440 Indo-European languages, is there only one clear case of a #TRV_i > #$TV(_i)RV_i$ sound change? And how should we understand the Siouan sister-languages Chiwere and Hoocąk, where Chiwere continues #TRV, but Hoocąk does not?

I suggest that cluster-splitting epenthesis is neither wholly natural nor wholly unnatural: non-phonetic structural and cognitive factors are involved. The structural condition is that cluster-splitting epenthesis occurs only when speakers of a language that *lacks* initial TR clusters begin to acquire a language that *has* initial TR clusters. It is only under this circumstance that the perceptual illusion of #TRV as #TVRV arises (cf. Dupoux et al. 1999), with this perceptual illusion constituting the cognitive catalyst for phonological change. An important component of this model is that regular sound changes of this kind will only occur under special types of language contact, where speakers dominant in a language that lacks initial consonant clusters suddenly (or without extensive exposure) acquire a language with #CR-clusters.[7] If extensive exposure occurs, perceptual illusions of phantom vowels will weaken, lowering the probability of epenthesis as regular sound change. Let us now evaluate this proposal with respect to the two cases of diachronic cluster-splitting epenthesis documented above.

[5] Dorsey's Law also refers to the resulting synchronic sound pattern in Hoocąk. It also applies to medial clusters. Since the syllabification of medial TR is ambiguous cross-linguistically, discussion is limited here to initial #TR where, at least utterance-initially, sequences constitute unambiguous complex onsets.

[6] Miner (1979: 25) begins his article with the statement that: "Winnebago and Chiwere … are, in spite of their geographical separation in historical times, very closely related and enjoy a high degree of mutual comprehensibility." He also notes on the same page (footnote 1) that "Winnebago-Chiwere is sometimes referred to in the literature simply as Chiwere."

[7] For a similar proposal regarding paragoge (final vowel insertion), see Ng (2015), a dissertation supervised by Steve Anderson.

Modern Persian phonology has had significant influence from Arabic and Turkic. Arabic loans constitute about half of the lexicon, and some estimate that of the most frequent vocabulary, at least 25% is Arabic (Perry 2004; 2005). Turkic loans also exist and there is a long history of Persian-Turkic bilingualism as well as Turkic "Persianization". Could acquisition of Persian by Arabic or Turkic speakers be the source of Modern Persian cluster-splitting epenthesis? I believe the answer is yes. More specifically, I suggest that the Persianization of Turkic people, such as the one occurring during the Ghaznavid dynasty (977–1186), and extending over large parts of Iran, was a critical factor in the evolution of cluster-splitting epenthesis in Modern Persian. Turkic languages have phonotactics that appears to be most important in triggering cluster-splitting-epenthesis: they disallow complex onsets in word-initial position (and elsewhere). Under this scenario, Middle Persian underwent rapid phonological change, as it was acquired by native speakers of Turkic languages across Iran. How early the process began is unknown, though it could have begun as early as the 10th century when Turkic speakers came to the area, or in the 11th and 12th centuries, when a large migration of Oghuz Turks resulted in the gradual "Turkification" of Azerbaijan and Anatolia (Frye 2004). Key (2012), who focuses on morphosyntactic effects of contact, suggests that Turkic influence may date from the Safavid state (1501–1736) "the rulers of which were Persianized Turks who spoke a variety of Middle Azerbaijanian that might actually have been a mixed language incorporating Ottoman elements (Stein 2005: 228)."[8] Frye (2004) presents a distinct view of the Safavids as Turkicized Iranians, but most seem to agree that it was the post-Islamic migration of Turks, as opposed to Arabic speakers, that had the most linguistic influence in the area: " …the Turks who came, especially beginning from the tenth century, moved in sufficient numbers to change the linguistic map of the whole area. (op cit.)"

Though Classical Arabic also disallows onset clusters, there are several reasons to doubt Arabic as the source of cluster-splitting epenthesis in Modern Persian. First, evidence from early loans into Classical Arabic shows common prothetic vowels, with epenthesis the exception (cf. Arabic *ʔiklīl* 'crown , wreath' from Syriac *klīlo*, Arabic *ʔiqlīm* 'region' from Greek *klīma*; but also Arabic *dirham* 'money' from Greek *drakhmi*; Bueasa 2015). Second, the influence of Arabic on Middle Iranian languages came, primarily, through translation of religious texts into Arabic, and through acquisition of Arabic by writers and thinkers who used it as a prestige language. This socialization process was notably different from the Persianization of Turkic people referred to above, and resulted in significant loans, but no obvious evidence of Arabic influence on Persian grammar.

I hypothesize that cluster-splitting epenthesis in the history of Persian arose as a result of contact between speakers of Turkic languages, which did not allow complex onsets, and speakers of Middle Iranian languages with initial #TR-clusters. As Turks became Persianized, they acquired Persian (and, perhaps, other Middle Iranian languages). In this process, cognitive effects of CV(C) syllable structure resulted in the perception of illusory vowels in #TR-initial words (cf. Dupoux et al. 1999), giving rise to the change in

[8] Key's (2012) study of differential object marking in Turkic and Persian identifies Iranian Azerbaijan as an isogloss for this feature.

pronunciation schematized in (3). Under this account, the rarity of sound changes like (3) is attributed to three factors: first, initial #TR clusters are relatively stable over time, so (3) is unexpected as a language-internal development; second, a sound change of this kind requires contact between two distinct language types, one language which lacks complex onsets and another which has word-initial #TR; a third factor is the nature of the language contact involved, which must include social factors that demand rapid and full acquisition of the language with #TR clusters despite minimal previous exposure.[9] Only when these last two conditions are met will cluster-splitting epenthesis occur as a regular sound change.[10]

Can the same hypothesis involving language contact of a very specific type account for the evolution of Dorsey's Law in Hoocąk (Winnebago)? I believe so. Oral histories suggest that the split between Hoocąk, traditionally spoken between Green Bay and Lake Winnebago in present-day Wisconsin, and Chiwere, once spoken south and west of Hoocąk territory, occurred sometime in the mid-16th century, a time-line consistent with the great similarity between the two languages.[11] This would make the mid-16th century the earliest time at which Hoocąk could have developed cluster-splitting epenthesis, an innovation not found in Chiwere (3). By the time Jean Nicolet made contact with the "Ho-Chunk" in 1634, with an estimated population of 8,000 or more, their culture was very similar to that of surrounding Algonquian tribes, they were completely encircled by speakers of Algonquian languages, and the language had a significant number of borrowings from Central Algonquian languages (Radin 1990; Pfister 2009: 17).[12] I suggest that sometime between the mid-16th and mid-17th centuries, (pre-)Hoocąk was acquired by speakers of neighboring Algonquian languages. Since none of the Central Algonquian languages had initial #TR clusters, cognitive effects of #CV(C) syllable structure resulted in the perception of illusory vowels in #TR-initial words (cf. Dupoux et al. 1999), giving rise to Dorsey's Law. As with the contact scenario sketched for Modern Persian above, the evolution of cluster-splitting epenthesis is associated not only with these structural-cognitive factors, but also with a specific type of language contact: external social factors demanding rapid and full acquisition of a language, (pre-)Hoocąk, with initial #TR clusters by speakers of a language Central Algonquian language with only simple #C-onsets word-initially.

[9] This process is distinct from creolization, since the starting point here is not a pidgin. Interestingly, many Creoles show initial complex onsets (Klein 2013), consistent with the view here, that they are relatively stable, and not particularly "marked".

[10] An anonymous reviewer notes that if future generations have access to the donor language, and that language is prestigious, one may see a shift involving adoption of the donor phonotactics.

[11] Though the homeland of the Siouan-Catawba language family is widely debated, oral histories and archeological remains are consistent with (pre)-Hoocąk occupation of land between Green Bay and Lake Winnebago (in present-day northeast Wisconsin) in pre-contact times.

[12] By the late 1650s, the Hoocąk population may have been as few as 500 people, with great cultural devastation. This drastic decrease in population is attributed to a storm-related accident, epidemics (due to European contact), and/or battle losses to neighboring tribes (Edmunds 1978; Radin 1990).

4 Concluding remarks

The typology of sound change may seem like an odd place to uncover significant evidence of cognitive forces that are independent of universal phonetics, or evidence against widely assumed markedness constraints.[13] Yet, this study of cluster-splitting epenthesis as regular sound change suggests that typological studies of this kind may illuminate our understanding of the role of human cognition in shaping sound patterns, and the extent to which general aspects of memory, category formation, similarity metrics, and analogy contribute to their evolution (Blevins & Blevins 2009). Contrary to widely assumed markedness constraints treating all complex onsets as marked or dispreferred, the typology of sound change suggests that word-initial #TR clusters are phonotactically stable. On the other hand, in the rare cases where these clusters undergo regular cluster-splitting epenthesis, this epenthesis is not a simple case of ”syllable-repair”. Rather, native-language #CV-structure in language-contact situations results in the perception of phantom vowels which take on phonological status when speakers of #CV-initial languages must quickly, and with little earlier familiarity, acquire a language with #TR clusters. This, I suggest, was the original situation of Turkic speakers acquiring Persian, and of Central Algonquians acquiring Hoocąk. Unlike many other common sound patterns, regular cluster-splitting epenthesis does not have a simple phonetic explanation, and is not known as a purely language-internal development. By examining other sound changes with this profile, we may, unexpectedly, learn even more about the human mind.

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[13] Though other instances of non-phonetic cognitive forces have been suggested. See, for example, Blevins & Wedel (2009), where lexical competition is argued to play an active role in shaping the typology of sound change.

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