Cross-derivational feeding is epiphenomenal[*]

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Baković (2005) proposes that patterns of sufficiently-similar segment avoidance are the result of interacting agreement and anti-gemination constraints, a pattern known as *cross-derivational feeding* (CDF). The bleeding interactions between epenthesis and assimilation which prevent adjacent sufficiently-similar segments in English are shown to follow, however, from extragrammatical considerations. Several case studies provide evidence against the major predictions of CDF.

1. Introduction

Languages often separate sequences of *sufficiently-similar segments* by synchronic processes of epenthesis. A textbook example can be seen with the phonologically-general allomorphs of the English regular preterite (and past participle) and noun plural (and 3sg. possessive, and 3sg. verb agreement) suffixes. These morphemes are assumed, following much prior work (e.g., Chomsky & Halle 1968: 210; Anderson 1973; Pinker & Prince 1988: 102; Baković 2005), to be underlying /-d/ and /-z/, respectively (the transcription given here is broad, omitting the opaque relationship between raising before voiceless stops and flap formation; see Idsardi 2006).[1]

		/-d/		/-z/	
	a.	næp-**t**	'napped'	læp-**s**	'laps'
(1)	b.	næb-**d**	'nabbed'	læb-**z**	'labs'
	c.	saɪt-**əd**	'sighted'	liːs-**əz**	'leases'
	d.	saɪd-**əd**	'sided'	tʃiːz-**əz**	'cheeses'

[1] If, however, the exponents are /-əd, -əz/, extrinsic ordering is unnecessary (see Miner 1975, Borowsky 1986: 135). Since such isolated claims have not tarnished the status of these patterns as *Paradebeispiele* of bleeding interactions, they are not considered further.

In a serial analysis, epenthesis in (1cd) occurs between consonants which have the same major place and CONT feature values. In (2), we use the feature-quantification notation developed by Reiss (2003) to express this as a condition on the rule's application.

(2)   EPENTHESIS: $\emptyset \rightarrow \partial$ / C[+OBS]$_1$ ___ C[+OBS]$_2$
        $\forall F_i \in \{\text{LAB}, \text{COR}, \text{DOR}, \text{CONT}\} : [(\alpha F_i)_1] = [(\beta F_i)_2]$

Assimilation of voice occurs after epenthesis, which bleeds it.

(3)   ASSIMILATION: $\begin{bmatrix} +\text{OBS} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{VOI} \end{bmatrix}$ / $\begin{bmatrix} +\text{OBS} \\ +\text{VOI} \end{bmatrix}$ ___

Eric Baković has noted a potentially-interesting fact concerning the above processes. To a first approximation, the one major feature irrelevant to the epenthesis rule in (3) is VOI, which is the very feature which is active in the process of assimilation. Baković (2005, 2006, 2007, 2010) argues that this is a generalization which the serial analysis has missed (though cf. Bye in press). This putative relationship between the irrelevance of voicing with respect to determining "sufficient similarity" and the voicing's participation in assimilation is easily expressed, however, is a consequence of global computation in Optimality Theory (OT). Baković proposes that sufficiently similar segments are disfavored by the constraint NOGEM; if it dominates DEP, epenthesis in *padded* is predicted. However, /td/ sequences, like the underlying form of *patted*, are not geminates per se; rather, the constraint forcing voice assimilation, AGREE(VOI), would give rise to geminates it is satisfied: it is for this reason that /td/ sequences are disfavored. When these constraints are undominated and unranked with respect to each other, the resulting interaction is called *cross-derivational feeding* (CDF).

(4)   English CDF constraint ranking (to be revised):
        NOGEM, AGREE(VOI) $\gg$ DEP(V), IDENT(VOI)

(5)

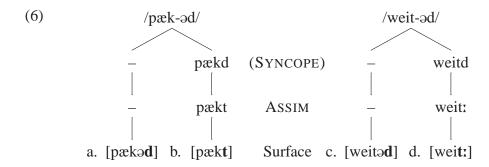|	/pæt-d/	NOGEM	AGR(VOI)	DEP(V)	ID(VOI)
a.	pæt**d**		*!		
b.	pæt**ː**	*!			*
☞ c.	pæt**ə**d			*	
d.	pæt**ə**t			*	*!

The CDF account makes two predictions. First, as noted by Pająk & Baković (2010), any feature ignored for the identification of sufficiently similar segments assimilates, since an AGREE constraint targeting that feature must be undominated to generate CDF. Secondly, a counterbleeding interaction between assimilation and a process which avoids sufficiently similar segments is predicted to be uncomputable (Baković 2007: 246). A counterbleeding candidate, like *[pætət] in (5d), is a "born loser", since both assimilation and epenthesis cannot be simultaneously motivated by these constraints.

In this study, we attempt to evaluate the merits of CDF. In the next section, consideration of the historical context that brought about the Modern English alternations demonstrates that the CDF pattern is the result of a plausible extragrammatical constraint; it is argued that it is not the case that sufficiently similar segments are disfavored synchronically: rather, they "underperform" in the sense that they are difficult for language learners to recover as instances of affixation at all. Such an analysis provides an extragrammatical explanation for this type of interaction between assimilation and epenthesis. §3–4 highlight problems that arise for the CDF analysis of Modern Standard English and of modern English dialects, respectively. §5–6 present evidence from Catalan and New Julfa Armenian, respectively, which provide counterexamples to the two predictions of CDF identified above. In §7, it is argued that data reported by Pająk & Baković (2010) necessitates that processes of epenthesis and assimilation in Polish be grammatically distinct, a separation explicitly denied by CDF. A final section (§8) concludes.
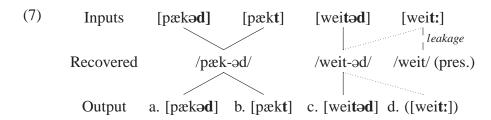
2.   /-d, -z/ in the history of English

The process of epenthesis in Modern English is the result of a reanalysis of an older process of syncope. By the end of the Old English period, sound change and extension of the most productive past tense allomorph to the two smaller weak verb classes resulted in a single weak past allomorph, /-əd/ (e.g., Hare & Elman 1995), and the plural /-əz/ was similarly generalized to all but a few nouns. Early in the Middle English period, a process of syncope targeting the unstressed vowels in these two suffixes was actuated. We assume that this rule was simultaneously actuated in all contexts, and that in all contexts, the rate of application increased in parallel (e.g., Kroch 1989; Fruehwald et al. in press). However, as we know from Modern English, syncope did not go to completion where it would produce final

geminates. Consider the derivation of two Middle English past tense verbs with variable syncope, schematized in (6).

(6)

	/pæk-əd/			/weit-əd/	
–	pækd	(SYNCOPE)	–	weitd	
–	pækt	ASSIM	–	weitː	
a. [pækəd]	b. [pækt]	Surface	c. [weitəd]	d. [weitː]	

Note that (6d) produces a word-final geminate. We propose that, given the lack of final geminates elsewhere in Middle English, language learners misperceived the marked category, i.e., geminates, as instances of the basic category, i.e., singletons (cf. Blevins 2004: 54, for a similar principle, Structural Analogy). The schema below illustrates a speaker misparsing a token /weitəd/ → [weitː] as an instance of the present /weit/.

(7)

Inputs	[pækəd]	[pækt]	[weitəd]	[weitː]	
					leakage
Recovered	/pæk-əd/		/weit-əd/	/weit/ (pres.)	
Output	a. [pækəd]	b. [pækt]	c. [weitəd]	d. ([weitː])	

One may object to the notion that (7d) could be systematically misparsed, since pragmatic context (as well as local syntactic cues like agreement morphology) might disambiguate the near-homophony. However, the study of natural misunderstandings suggests that speakers are unable to reliably deploy pragmatic knowledge to correct misunderstanding. Labov (2010) reports fifteen misunderstandings involving the pairs *copy/coffee* and *Dawn/Don* (which share the same vowel for many speakers), misunderstandings which persisted despite the discourse salience of the target word.

(8)   D. Sankoff: It's time to make the copies.
        W. Labov: But I've already had my coffee. (Labov 2010: 33)

These data suggest that misunderstandings resulting from near-homophony are quite frequent, and potentially operative in language change.

What would speakers make of the low rate at which they perceived syncopated [weitː] as an instance of the past tense? Indeed, would speakers' grammars track this fact at all? We assume, following a large body of work (Labov 1969; Cedergren & Sankoff 1974), that the rates at which variable phonological processes apply in different environments are a target for acquisition. Some of the most convincing evidence for this strong hypothesis is given by a study of the pronunciation of *ing* as a coronal nasal (i.e., [ɪn]; this process is sometimes imprecisely called "*g*-dropping"). Labov (1989) finds that children match the rates at which their parents use this variable in different morphological environments by age seven. During acquisition, if children encounter unambiguously-syncopated tokens of /t, d/-final stems at a much lower rate than other contexts, and if this low rate of application to /t, d/-final stems is allowed to propagate through the speech community, the modern pattern emerges: the result of syncope is projected into the underlying form the past tense and noun plural morphemes, and epenthesis in /t, d/-final stems is innovated.[2] The distribution of surface forms over time is schematized for the past tense (cf. Mondon 2009b: 36).

		/t, d/-final stems	elsewhere
(9)	Early Middle English	[-əd]	[-əd]
	Syncope activated (ə → ∅)	[-əd ∼ -d]	[-əd ∼ -d]
	Variation becomes lopsided	[-əd ≫ -d]	[-əd ≪ -d]
	Modern Standard English	[-əd]	[-d]

Jespersen (1942: 267) makes a similar suggestion: "The retention of the weak vowel in -*ses* as in *glasses*, etc., is a kind of reaction against the general tendency to drop it, due in the first place to the want of distinctiveness, as the two numbers would otherwise be identical."[3]

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[2] We wish to remain agnostic about the relative chronology here: perhaps learners posited a more restricted syncope rule and/or epenthesis before restructuring took place.

[3] A lingering issue is the development of "zero" pasts, those verbs such as *bid* or *hit* which do not change in the past. Old English had a class of /Ct, Cd/-final stems which formed preterites in /-e/ (Moore & Knott 1919: 185). This vowel reduced (Jespersen 1948: 186), then was apocopated in Middle English (Jespersen 1942: 27f.). Modern reflexes of this class which maintain the zero past include *set*, *shut* and *spread*. However, the modern-day zero class includes many etymologically strong verbs and borrowings from Old Norse (e.g., *cast*), Norman French (e.g., *cost*), and Middle Dutch (e.g., *split*). This modern class contains only short-vowel stems, whereas long-vowel stems ending in /-t, -d/ are either ablauting (e.g., *stride*), shortening (e.g., *read*), or simply regular with epenthesis. It can be said, then, the homophony that would result from regular sound change has endured only in a lexically-conditioned subset.

This leakage account is mechanistic and extragrammatical, and therefore is in stark contrast to grammatical accounts of homophony avoidance (e.g., Crosswhite 1999; see an assessment of this and similar work in Mondon 2009b). By distinguishing between tendencies emerging from cycles of acquisition and change on one hand, and those grammars which are computable on the other (e.g., Buckley 1999; Blevins 2004; Cohn 2008; Hale & Reiss 2008), we are able to maintain a parsimonious phonological theory. In §4–7 below, we present evidence that CDF is too restrictive.

3.   /-z/ in Modern Standard English

This section considers a problem for the CDF analysis of the regular noun plural in Modern Standard English. There is epenthesis not only between /-z/ and stems ending in /-s, -z/, but also alveopalatal /ʃ, ʒ, tʃ, dʒ/.

(10)
    a.   dɪʃ-**əz**   'dishes'
    b.   jʌdʒ-**əz**   'judges'

Neither /ʃs/ nor /dʒz/ are geminate sequences, and there is no assimilation process mentioned thus far that could map them onto true geminates. Consider the result of adding a high-ranked AGREE(ANTERIOR) constraint.

(11)

/dɪʃ-z/	NOGEM	AGR(VOI)	AGR(ANT)	DEP
a. dɪʃ**z**		*!	*	
b. dɪʃ**ː**	*!			
c. dɪʃ**s**			*!	
☞ d. dɪʃə**z**				*

This is the only evidence for a high AGREE(ANTERIOR) constraint, as sequences of consonants differing only on subcoronal place do not in general occur inside the prosodic word. As for these sequences of coronal consonants disagreeing on sub-coronal place, a few phonological texts have claimed that there is sub-coronal place assimilation (Roach 1983:14; Lodge 1984: 2; Mohanan 1986:7). However, a host of experimental studies (Catford 1977: 223f.; Local 1992: 210f.; Holst & Nolan 1995; Zsiga 1995; Pouplier et al. 2011; Niebuhr et al. in press) have demonstrated that coarticulation between phrase-internal coronal obstruent sequences which differ in sub-coronal features may be (unexpectedly) regressive, and, in the case of /s ∼ ʃ/, *not* contrast-neutralizing, so no phonological explanation is merited.

The rule stated in (2) does not need to be modified to account for this data, and the historical account given above can explain this outcome of syncope if we simply allow that word-final sequences of segments differing only on sub-coronal place features pose the same sort of recoverability problem that word-final geminates do.[4]

4.   /-z/ in English dialects

Data from English dialects with advanced rates of deletion of final /t, d/ in consonant clusters suggest that geminate avoidance may not always be relevant to the application of epenthesis. Labov et al. (1968: 331) give the following close transcriptions of *ghosts* as produced by "Money", a speaker of African-American Vernacular English (AAVE) from Harlem, NYC:

(12)
    a. gosː
    b. gosɨz
    c. gostsɨs

The final devoiced geminate in (12a) violates both NOGEM and AGREE(VOICE), and the doubly-affixed (12c) incurs a gratuitous violation of faithfulness. Other data suggest that epenthesis may occur when there is no risk of geminate formation, such as after stem-final /st/; Wright (1905: 261) and Jespersen (1948: 189) report the following British dialectical forms:

(13)
    a. ⟨bist**es**⟩ 'beasts'
    b. ⟨post**es**⟩ 'posts'
    c. ⟨gost**es**⟩ 'ghosts'

This also occurs in higher registers of AAVE; the following was heard by the first author during a panel discussion:

(14)
    a. kənsɪst-**əz** 'consists'
    b. dʌst-**əz**   'dusts'

Both (13) and (14) follow from the leakage account if /t/ was lost completely, and then later added in by contact with dialects which at least vari-

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[4] Baković & Kilpatrick (2005) find some evidence for post-alveolar coarticulation in words like *mashed* and *matched*, but they recognize that their results do not provide any evidence for assimilation to a post-alveolar place of articulation (e.g., [t̠]) predicted by the activity of an AGREE(ANTERIOR) constraint.

ably preserved it. Jespersen alludes to some orthoepic evidence that the [t] in ⟨bis**tes**⟩ is a reaction to the stigmatization of /t, d/-deletion in the London area in the 17th century, and /t, d/-deletion is basically complete in the AAVE basilect, but deletion is much less advanced in Modern Standard English. While NoGem could be reformulated to ignore the /t/, whether it is epenthetic or underlying, such an account would scarcely preserve the original intuition that geminate avoidance triggers epenthesis.

5. Sufficiently-similar deletion in Catalan

Cameron et al. (2010) consider a process in Catalan which deletes a word-final obstruent when preceded by a homorganic sonorant, shown in (15).[5]

		masc. sg.		*fem. sg.*	
	a.	al		**alt**ə	'tall'
	b.	kur		kur**t**ə	'short'
(15)	c.	blaŋ		blaŋ**k**ə	'white'
	d.	prufun		prufu**nd**ə	'deep'
	e.	əskerp	(*asker)	əske**rp**ə	'shy'
	f.	ɣark	(*ɣar)	ɣa**rɣ**ə	'long'

Observing from (15ef) that homorganicity is necessary for deletion to apply, Cameron et al. analyze it as a condition on rule application.

(16) HOMORGANIC DELETION: $C[+Obs]_1 \rightarrow \emptyset \ / \ C[+Son]_2 \ \_\_ \ \#$
$\forall F_i \in \{Lab, Cor, Dor\} : [(\alpha F_i)_1] = [(\beta F_i)_2]$

In phonotactic terms, the "pathology" is a sequence of sufficiently similar segments, and this would appear to fall under the purview of CDF, despite the different "cure", i.e., deletion. The CDF analysis must posit high-ranked AGREE constraints to account for the fact that manner is ignored for the determination of sufficient similarity. This incorrectly predicts, however, that all manner features will assimilate. For 'shy (masc. sg.)', undominated AGREE(MANNER) constraints will rule out the winning [əskerp], instead favoring *[əsker]. No such problem is encountered with (16).

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[5] At the suggestion of an anonymous reviewer, we have replaced Cameron et al.'s [lʸ] in (15f) with [ɣ].

6. Counterbleeding in New Julfa Armenian

Baković, following Kenstowicz & Kisseberth (1971), makes the claim that epenthesis counterbled by assimilation is unattested, but a counterexample comes from the future proclitic /k-/ in the New Julfa dialect of Armenian (Vaux 1998: 216; Vaux in press) shown in (17).

	a.	**k**ətam	'I will come'
	b.	**g**əlam	'I will cry'
(17)	c.	**kʰ**ətʰuoʁniem	'I will allow'
	d.	**gʰ**ədʰəniem	'I will put'
	e.	**gʰ**avadam	'I will believe' (cf. **h**avadam 'to believe')

Since laryngeal state assimilates even when epenthesis applies, Vaux proposes that assimilation applies after epenthesis. This non-interaction is inexpressable in "classic" OT, however, since the winning candidates in (17b-e) all incur gratuitous violations of faithfulness.

Discussing this data, Baković (2007: 247) suggests that epenthetic vowels can be transparent to the AGREE family, and further suggests this would be falsified only by a counterbleeding pattern where epenthesis appears to apply over epenthetic vowels which are "distributionally distinguishable from otherwise identical underlying vowels ... and in which assimilation applies only across the epenthetic vowels". "Distributionally distinguishable" is in the eyes of the beholder, however. This can be seen from the fact that Vaux (2003: 104f.) motivates his treatment of root-internal [ə] as epenthetic not for phonetic or phonological reasons (as one might expect), but rather to account for opacity in allomorph selection. Baković argues that "to the extent that the type of pattern considered in this subsection is indeed unattested, OT has a clear advantage over *SPE*, in which the analysis of this unattested pattern is as straightforward as any other." This too is too strong, since Baković (op. cit., fn. 20) suggests two ways this could be encoded in OT by "brute force". In other words, this claim to formal restrictivity is nothing more than an undefined notion of the relative elegance of analyzing counterbleeding-on-environment interactions in OT and serial phonological theories, and therefore has little probative value. The above claim above a familiar problem in grounding phonology in typology: what is taken to be a structural gap is later shown to be an artifact of sampling.

7. Geminate avoidance and speech rate in Polish

Pająk & Baković (2010, henceforth P&B) argue that data from Polish also supports the formal connection between epenthesis and assimilation. Voicing assimilation targets the /z-/ proclitic, as in (18b).

(18) a. **z**bʑikɔvãt͡ɕ 'to become crazy'
      b. **s**kfasɛm   'with acid'

There is also an "optional" rule of sub-coronal place assimilation.

(19)
	assimilation	*¬ assimilation*	
	ʐd͡ʐvʲigʲɛm	**z**d͡ʑvʲigʲɛm	'with a crain'

CDF thus predicts that voicing, and optionally sub-coronal place, will be ignored for the computation of sufficient similarity. However, epenthesis does not apply when a "simple" geminate is formed. Rather, the process of epenthesis (the descendent of a restructured process of *jer*-deletion; cf. §2) applies optionally to clusters where a sequences of sufficiently-similar segments would be followed by another consonant, as in (20c).

(20)
		epenthesis	*¬ epenthesis*	
	a.	***s**ɛsɛrɛm	**s**ːɛrɛm	'with cheese'
	b.	***z**ɛzamku	**z**ːamku	'from a castle'
	c.	**z**ɛʐrɛbakʲɛm	**z**ʐrɛbakʲɛm	'with a colt'

As can be seen from (21) below, epenthesis bleeds assimilation (NB: *c.b.* denotes the results derived from a counterbleeding application of assimilation and epenthesis). The column marked *assimilation* indicates that if epenthesis fails to apply, assimilation is ruled out in this environment.

(21)
		epenthesis	*assimilation*	*c.b.*	
	a.	**z**ɛznakʲɛm	***z**ːnakʲɛm	(n.a.)	'with a sign'
	b.	**z**ɛskawɔ̃	***s**ːkawɔ̃	***s**ɛkawɔ̃	'with a rock'
	c.	**z**ɛʐrʊdwa	***z**ːrʊdwa	***ʐ**ɛʐrʊdwa	'from a spring'

Despite the minor complication that the analysis requires a contextual version of the NOGEM constraint (since geminates are permitted except immediately before other consonants), the data presented appear to be consistent with the first prediction of CDF: as shown, voice and sub-coronal place are ignored for the computation of sufficient similarity, and both assimilate.

P&B make a much stronger claim, however. Recall that in Polish, epenthesis may apply where sub-coronal place assimilation would counter-factually create a cluster of a geminate followed by a consonant, and that both epenthesis and sub-coronal place assimilation are both variable. P&B suggest that this variability suggests they share a single grammatical motivation (in this case, the high ranking of an AGREE constraint, which is taken to be "stochastically active" to generate this variation), despite the fact that, as P&B note, the rates at which sub-coronal place assimilation and epenthesis apply are very different. We are not convinced that mere presence of variability in two processes indicates that they are motivated by the same constraint.

P&B refer to a comment by a reviewer of their study, who notes that in Polish, epenthesis occurs more often in slow speech, whereas sub-coronal place assimilation occurs less often. P&B claim that this can easily be accommodated if the ranking of the high-ranked AGREE constraint is sensitive to speech rate. However, this is not the full story: the ranking (i.e., "activation" in their terms) of this constraint must make reference both to speech rate and also to whether a candidate exhibits sub-coronal place assimilation or epenthesis; in the former case, slow speech decreases the activation of high AGREE, and in the latter, slow speech increases the activation of the Agree constraint. As shown in (21), these environments overlap, so epenthetic candidates cannot be evaluated by the same ranking as assimilated candidates. This seems to deny Richness of the Base.

Even if we admit this powerful mechanism into the theory of grammar, variationists have long speculated (e.g., Sankoff & Labov 1979: 212f.) that there are no interactions between grammar-internal predictors of linguistic variation (in this case, the different contexts in which epenthesis and place assimilation occur) and grammar-external (but speaker-internal) predictors (such as speech rate), which is confirmed by a recent survey of the literature (MacKenzie forthcoming). MacKenzie makes the intuitive argument that this state of affairs is exactly what is predicted if, contra P&B, speaker-internal differences in "style", register, speech rate, etc., do map onto slightly different grammars. In conclusion, the evidence from variation in Polish provides additional evidence for the hypothesis that the triggers of sub-coronal place assimilation and epenthesis are independent.

8. Conclusion

The above case studies show that CDF is too restrictive to account for known grammars, and is better understood as a tendency resulting from historical interaction between processes that produce homophony. This account provides a morphophonological mechanism by which homophony avoidance might be understood, though it does not necessarily rule out a phonetic account. Odden (1988: 470) proposes that the gestures of non-identical consonants may show more partial overlap than repeated identical gestures, which in turn could lead to phonetically shorter vowels between non-similar consonants, which are in then more likely to be deleted than the longer vowels between similar consonants.

We further propose that the leakage account given in §2 may be the source of apparent exceptions to the regularity of sound change which produce homophony (e.g., Labov 1994: part E; Guy 1996; MacKenzie 2010; Mondon 2009a,b). Future work will investigate the role of morpheme and word in conditioning this underapplication, synchronically and diachronically.

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