DEP: Beyond Epenthesis

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1 Introduction

The correspondence-theoretic constraint DEP (McCarthy and Prince 1995) is often informally described as a constraint against epenthesis. While DEP does militate against epenthesis in input-output mappings, it has a more technical sense when applied to other domains, such as base-reduplicant correspondence and output-output correspondence. The goal of this squib is to show that DEP constraints do more than block epenthesis. In the domain of base-reduplicant correspondence, the high ranking of DEP-BR can result in underapplication of deletion, as in the case of Tonkawa. In the domain of output-output correspondence, DEP-OO is known to require overapplication of deletion in paradigmatically related forms. All of these effects follow from McCarthy and Prince's definition of DEP as a family of faithfulness constraints that require a match between two strings that stand in correspondence.

This discussion sheds light on a long-standing ambiguity in classic Optimality Theory: does the treatment of epenthesis really require a faithfulness constraint, or is markedness sufficient? On the face of it, epenthesis is an unfaithful mapping, and as such should violate faithfulness. As Prince and Smolensky (1993/2004) and McCarthy and Prince (1993) point out, however, epenthesis typically compounds markedness violations, as well—for example, if a candidate contains an epenthetic [h], it incurs one more violation of the constraint against the feature [spread glottis] than candidates without [h]-epenthesis. If we follow Prince and Smolensky (1993/2004), McCarthy and Prince (1993), and Zoll (1996) in assuming that

Con includes *Struc constraints against all structure, then faithfulness constraints against insertion seem to be redundant. This purported redundancy has been pointed out and criticized continuously since the earliest days of OT (Myers 1994, Bernhardt and Stemberger 1998, Causley 1999, Urbanczyk 2006). Most of the arguments against DEP rest on the claim that *Struc constraints are independently necessary outside of the domain of epenthesis, whereas Dep is at best redundant and at worst harmful—blocking epenthesis in this view is a matter of structural markedness, not faithfulness. Here, I present arguments that Dep is far from redundant; in fact, a *Struc reanalysis of the patterns discussed here would be impossible.

2 Why Dep is not equivalent to *Struc

To appreciate the difference between Dep and *Struc, we should start by looking at the definition of Dep. McCarthy and Prince's Correspondence Theory of faithfulness establishes a correspondence relation $\Re$ between pairs of representations (strings), including input-output (IO), base-reduplicant (BR), and output-output (OO). The Dep family of constraints is then defined as follows:

(1) Dep: Every element of S_2 has a correspondent in S_1. Range $(\Re)=S_2$. (McCarthy and Prince 1995)

By virtue of its definition, Dep is capable of distinguishing two identical segments in different candidates based on their correspondence relations alone. This is something that markedness constraints (including *Struc) cannot do, since markedness constraints only have access to a single level of representation—the output. For input-output correspondence, this means simply that no segments of the output can be inserted—no mappings of the form $/p_1k_2a_3/ \rightarrow p_1\underline{i}k_2a_3$, where [i] is an epenthetic vowel without lexical affiliation. For other types of correspondence, Dep really need not have anything to do with this type of epenthesis at all, as will be demonstrated next.

3 Dep-BR blocks syncope in Tonkawa

In the domain of base-reduplicant correspondence, Dep is violated by segments that appear in the reduplicant morpheme (S_2) but not in the string that constitutes the reduplicative base (S_1). From the point of view of the base, such segments are "inserted," but they are not epenthetic in the same sense as a vowel that has no morphological affiliation is epenthetic. Thus, Dep-BR can be crucially active in two distinct circumstances: (i) if it blocks "true" epenthesis of non-lexical material in the reduplicant,[1] and (ii) if it blocks deletion of lexical material from the reduplicative base. Here, I present a case of the latter type: in Tonkawa, Dep-BR is crucially active in ruling out the normal application of syncope just in case base-reduplicant identity is at stake.

Tonkawa has a well-known process of syncope, which deletes the second short vowel in a two-sided open syllable (Hoijer 1933, Kisseberth 1970, et seq). The examples below show that syncope applies to the second vowel in both roots and prefixes, as long as the vowel is flanked by a #CVC___CV sequence and the two consonants on either side of the vowel are non-identical.[2]

(2) Syncope in the non-reduplicative phonology of Tonkawa (Hoijer 1933, 1949)[3]

/notoxo-oʔ /	not.xoʔ	'he hoes it'
/we-notoxo-oʔ/	wen.to.xoʔ	'he hoes them'
/ke-we-yamaxa-oo-ka/	kew.yam.xoo.ka	'you paint our faces'
/picena-oʔ/	pic.noʔ	'he cuts it'
/he-yakapa-oˀs/	hey.ka.poˀs	'I hit myself'
/ke-netale-oˀs/	ken.ta.loˀs	'he licks me'

I analyze syncope in metrical terms: it creates heavy syllables, which can be iteratively footed (see also Gouskova (2003)). According to Hoijer, "Tonkawa utterances consist of a succession of more or less evenly stressed syllables" (1946:292). Hoijer does not mark stress on any of his examples, but his description suggests the presence of strong secondary stresses and therefore of iterative footing. Further evidence from the distribution of long vowels allows us to infer that the feet[4] are trochaic: long vowels occur in initial syllables, but they shorten following an initial CV̆ syllable. Shortening does not apply outside of the context #CV̆C___C. . . , so long vowels are free to occur later in the word—including after an initial CVC or CVV syllable. This is expected if footing is iterative: in a sequence of heavy syllables, each forms its own foot, so the second syllable in a #HH sequence is metrically strong and does not need to shorten. Thus, the context for both shortening and second-syllable syncope is basically the same: both apply to what would be the weak branch of a trochaic foot.

(3) Distribution of long vowels and footing in Tonkawa

No shortening in initial syllable or later in the word			Shortening after CV-	
/kaana-oʔ/	(káa)(nóʔ)	'he throws it away'	(xá-ka)(nóʔ)	'he throws it far away'
/nes-kaana-oʔ/	(nés)(káa)(nóʔ)	'he causes him to. . . '		
/yaaloona-oʔ/	(yáa)(lóo)(nóʔ)	'he kills him'	(ké-ya)(lóo)(nóʔ)	'he kills me'
/taa-notoso-oˀs/	(táa)(nót)(sóˀs)	'I stand with him'	(ké-ta)(nót)(sóʔ)	'he stands with me'
/we-tasa-sooyan-oˀs/	(wét.sa)(sóo.ya)(nóˀs)	'I swim off with them'		

For reasons of space, I will not present a full analysis of syncope and shortening here, since the pattern is fairly complex in ways not relevant to the main point. For syncope, the relevant metrical constraints are the Stress-to-Weight Principle "stressed syllables are heavy" (Fitzgerald 1999, Prince 1990) and Parse-σ "syllables are dominated by feet," which both dominate MAX-V. Thus, a second vowel must delete to turn /CVCV/ into a heavy closed syllable CVC, since heavy stressed syllables are preferred to light ones despite the unfaithfulness. Not footing the first two syllables is ruled out by PARSE-σ. Vowel deletion and shortening are the only quantitative adjustments possible in Tonkawa—other options, such as coda gemination or vowel lengthening, are generally ruled out in the language.[5]

(4) Syncope in non-reduplicative phonology

/notoxo-oʔ/	PARSE-σ	SWP	MAX-V
(nót)(xóʔ)∼(nó.to)(xóʔ)		W	L
(nót)(xóʔ)∼no.to.(xóʔ)	W		L

While Tonkawa syncope is a familiar problem, Tonkawa has not figured in theories of reduplication. Interestingly, in reduplication, syncope does not apply. Even though the reduplicant is a CV- prefix, the second vowel of the word does not syncopate. For many of the words below, there is evidence that the relevant vowels can syncopate in regular, non-reduplicative affixation, and Hoijer marks the vowels as deletable in his (1949) dictionary.

(5) Tonkawa reduplication: underapplication of syncope in 2nd syllable (Hoijer 1933:7)[6]

top-oˀs	to-top-oˀs	'I cut it/rep.'	*to-tp-oˀs
kom-oˀs	ko-kom-oˀs	'I have it in my mouth/rep.'	cf. wo-km-oˀs 'I have them...'
kʷet-oˀs	kʷe-kʷetaw-oˀs	'I carry him in my arms/rep.'	
cex-oˀs	ce-cex-oˀs	'I turn him loose/rep.'	

I argue that this underapplication of syncope is due to DEP-BR, which demands identity between the base and the reduplicant. If the vowel in the base were deleted, as in *to_1-tpoˀs, the reduplicant vowel would have no correspondent in the base, violating DEP-BR. DEP-BR must therefore outrank the constraints that favor syncope, such as the SWP. Metrical constraints are violated just in case base-reduplicant identity is at stake but obeyed when DEP-BR is irrelevant:

(6) Underapplication of syncope in Tonkawa reduplication

		Dep-BR	SWP	Max-IO
/RED-topoˀs/	(tó$_{1}$.to$_{1}$)(póˀs)∼(tó$_{1}$t)(póˀs)	W	L	W
/we-notoxo-oʔ/	(wén.to)(xóʔ)∼(wé.no)(tó.xoʔ)		W	L

One might ask why Tonkawa doesn't solve both reduplicant identity and its syncope problem by simply copying more of the base. If *to.poˀs* were reduplicated as **top-to.poˀs*, the form would satisfy SWP, and Max-BR would be satisfied better, too. The answer is that the CV size restriction on Tonkawa reduplicants is absolute; even long vowels are copied as short (see Gouskova (2006)). This size restriction also partially explains the failure of **too.topoˀs*, though lengthening is generally not attested in Tonkawa, in reduplication or otherwise.

A number of Tonkawa words follow a different pattern: they reduplicate the second or third CV- sequence of the base rather than the first. Hoijer hypothesizes that for these, the first CV sequence is a prefix (or "theme," in his words). When the reduplicant is preceded by such a CV- prefix, syncope does not apply, even though the second vowel of the word is in the syncope environment.

(7) Tonkawa non-initial reduplication (Hoijer 1933: 8, 61-63)

a. /he-RED-pak-oˀs/	he.pa.pa.koˀs	'I tell him several times'	
b. /na-RED-wel-oˀs/	na.we.we.loˀs	'I spread it out (rep)'	cf. naw.loʔ 'he...'
c. /we-na-RED-wel-oˀs/	wen.we.we.loˀs	'I spread them (rep)'	*wen.wew.loʔs
d. /ke-RED-topo-oˀs/	ke.to.to.poˀs	'he cuts me (rep)'	

Syncope underapplies in second syllable not only because of base-reduplicant identity requirements but also because of a well-known categorical prohibition on identical adjacent consonants (**hep.pakoˀs*), which holds throughout the language (Kisseberth 1970, McCarthy 1986). Note, though, that syncope is blocked even when this prohibition is not an issue– in (7c), the base vowel stays even though deleting it would not bring identical consonants together.[7] This is correctly predicted by Dep-BR: what rules out syncope in (7c) is base-reduplicant identity.

4 Alternatives to Dep-BR

Would it be possible to construct an analysis of Tonkawa underapplication without Dep-BR? There are several possibilities.[8] First, underapplication of this sort could lend itself to a derivational analysis, whereby syncope applies before reduplication in a counterfeeding order:

(8) A rule-ordering alternative analysis of Tonkawa

Input	/topo-oˀs/	/notoxo-oʔ/
Syncope	—	not.xoʔ
Reduplication	to.to.poˀs	—
Output	[to.to.poˀs]	[not.xoʔ]

This analysis runs into difficulty explaining the data in (7), however. If syncope applied before reduplication to /he-RED-pak-oˀs/, it would yield *hep.koˀs*, deleting the very vowel that the counterfeeding order is supposed to preserve. It is important to note also that the prefix *he-* conditions syncope in non-reduplicative forms: /he-yakapa-oˀ/ *hey.ka.poˀs* 'I hit myself,' /he-wel-oˀs/ *hew.loˀs* 'I catch him' (cf. /yakapa-oˀs/ *yak.poˀs* 'I hit him,' /kee-wel-oˀs/ *kee.we.loʔ* 'he catches me' (1933:9)). If external affixes attach last, as is typically assumed, then syncope must be ordered after all the affixes have attached—including the reduplicant. If reduplication followed syncope, then *he*-prefixation would have to follow syncope, as well, yet *he*-prefixation conditions syncope. The same is true for the prefixes *we-* and *na-*: the fact that the prefix *na-* itself undergoes syncope in *wen.we.we.loˀs* 'I spread them (rep.)' would suggest that it attaches before syncope applies. In the present analysis, morphemes attach at the same time as the content of RED is supplied by GEN, and the application of syncope is blocked not by the ordering of syncope with respect to reduplication and other affixation but by the prohibition on adjacent identical consonants and by Dep-BR.

Another possibility is that there is a base-reduplicant identity constraint at work, but it is not Dep-BR. StRole (McCarthy and Prince 1993) requires that elements standing in base-reduplicant correspondence have the same structural (prosodic) role. McCarthy and Prince call upon this constraint to explain why Chamorro RED suffix copies a medial consonant of the base, [ɲa.la.laŋ], rather than the final one, *[ɲa.la.ŋaŋ]. StRole would also favor underapplication in *to.to.poˀs* over **tot.poˀs*, since in the normal application candidate an onset [t] stands in correspondence with a coda [t]. The problem with this constraint, though, is that the most obvious way to satisfy it is to prosodify the output differently, as in *[ɲa.laŋ.aŋ]. To my knowledge, this kind of resyllabification is not attested. Calling on Onset to rule out resyllabification does not offer a universal solution to the problematic prediction. This issue is a general one for prosody-referring faithfulness constraints (for some discussion, see Beckman 1998:37, fn. 27).[9] McCarthy and Prince (1994) themselves subsequently move away from StRole, reanalyzing Chamorro in terms of prosodic subcategorization constraints. Since Dep-BR does not make this prediction of resyllabification, it appears to be a safer analysis of underapplication.

The third alternative is that syncope fails for structural reasons: the reduplicant stands outside of the prosodic word that contains the base, in a nested prosodic word structure *[to[to.poˀs]]*. Under this analysis, syncope would be impossible because *[to-t.poˀs]* fails to align morphological and prosodic boundaries. This analysis also fails to be supported by the morphology of Tonkawa. It encounters some of the same difficulties with (7) as the rule-ordering analysis. Moreover, non-reduplicative affixes routinely induce shortening in the following syllable, which receives a simple explanation if the affix and the base are footed together. RED similarly conditions shortening of the following vowel (Gouskova 2006), which would be a mystery in a nested prosodic word analysis.

*Struc also does not work as a substitute for Dep-BR in the analysis of Tonkawa for a simple reason: *Struc actually favors syncope, so it needs to be dominated by Dep-BR. The syncopated candidate **tot.poˀs* loses despite having fewer syllables and therefore less structure than *to-topoˀs*. The need to rank *Struc below Dep-BR is a sure indication that the two constraints are not equivalent. Underapplication of syncope must be a matter of base-reduplicant identity—faithfulness, not markedness.

*Struc fails not only in Tonkawa—it does not work as a replacement for Dep-BR generally. In the Tonkawa example, Dep-BR has the effect of preventing deletion in the base rather than epenthesis in the reduplicant. Even if Dep-BR militated only against "true" epenthesis in the reduplicant, as in the hypothetical /RED-apa/ *h̲a-apa*, *Struc cannot take over its function. To limit epenthesis in the reduplicant, *Struc would have to be split into *Struc-RED and regular, or "base" *Struc. This encounters a conceptual problem, identified by Pyle (1972), of having to assign a morphological affiliation to a segment that doesn't have one (McCarthy and Prince (1993) make this point in their discussion of Consistency of Exponence). Even if this split could be sensibly implemented, it would presumably have to be extended to all markedness constraints. Since markedness constraints are far more numerous than faithfulness constraints, this would entail a considerable enlargement of Con compared to the relatively modest addition of Dep to the set of faithfulness constraints in McCarthy and Prince's version of Correspondence Theory.

One of the purported advantages of replacing constraints such as Dep with *Struc is that *Struc makes for a simpler theory with fewer constraints (a point made by Causley 1999, Myers 1994, Bernhardt and Stemberger 1998, and Urbanczyk 2006). When the role of Dep in the BR domain is taken into account, however, it becomes apparent that *Struc is not only incapable of doubling for Dep-BR but that the set of constraints does not necessarily diminish.

5 Dep-OO

In the domain of output-output correspondence (Benua 1997, inter alia), Dep-OO likewise does more than simply block epenthesis of non-lexical structure. Dep-OO is violated whenever a segment is present in a morphologically derived form but has no correspondent in the derivational base. This situation can arise whether the segment has a lexical affiliation or not, and Benua (1997) discusses cases of both types. I argue that neither case lends itself to a markedness analysis.

In Tiberian Hebrew (see (9)), all coda clusters are broken up by epenthesis in underived words (Prince 1975). In words derived by truncation, however, consonant clusters are broken up by epenthesis only if they have rising sonority; falling and flat sonority clusters remain clusters. Benua's analysis attributes this blocking of epenthesis in derived forms to the pressure to be similar to the derivational base of truncation (given on the left in (9b, c)).

(9) Tiberian Hebrew underapplication of epenthesis in derived words (Gesenius 1910, Benua 1997, Prince 1975)

a. Normal application of cluster simplification in non-derived words: all clusters

/malk/	mele̲x	'king'
/sepr/	sefe̲r	'book'
/qodš/	qoθe̲š	'sacred'

b. Underapplication of cluster simplification in derived words: flat/falling sonority

yišbe	yišb	'take captive (impf/jussive)' not *yiše̲β
yiɸte	yiɸt	'be simple (impf/jussive)' not *yiɸe̲θ

c. Normal application of cluster simplification in derived words: rising sonority

yiɣle	yiɣe̲l	'uncover (impf/jussive)'
yiβne	yiβe̲n	'build (impf/jussive)'

Here, Dep-OO blocks epenthesis of non-lexical material, but only in morphologically derived words. There are two partially overlapping patterns of epenthesis in Tiberian Hebrew:

general cluster simplification, which applies to non-derived words, and the more specific rising sonority cluster simplification, which applies to derived ones. To get this kind of subset/superset relationship, we need two anti-epenthesis constraints ranked in two different places in the hierarchy. Benua proposes the following ranking, where SonCon refers to the relevant sonority constraints:

(10) Tiberian Hebrew: SonCon≫Dep-OO≫*ComplexCoda≫Dep-IO

Under this ranking, all complex codas will be simplified in input-output mappings such as /malk/ → *melex (*SonCon, *ComplexCoda≫Dep-IO), but any mappings that involve a derivational base will be subject to Dep-OO as well as Dep-IO. Thus, *yišb* must be faithful to its input /yišbe+TRUNC/ and to its OO-base *yišbe*. Dep-OO blocks epenthesis only in *yišb*, and only as long as sonority does not rise. Tiberian Hebrew demonstrates the need for Dep—moreover, it shows that there is more than one Dep constraint in CON. Even though here, Dep-OO is performing its vanilla function of blocking epenthesis of non-lexical material, its work cannot be easily subsumed by *Struc. Presumably, the epenthetic [e] is just as marked in the jussive form derived from the verb as it is in the underived noun form—and it has no morphological affiliation in either the the jussive or the noun. The failure of epenthesis is a matter of morphology and faithfulness, not general markedness.

Benua (1997) also argues that Dep-OO is responsible for the overapplication of English cluster simplification in derived forms, where the segment that is not allowed to surface is actually a lexical segment. In English, medial clusters such as [mn] are freely tolerated in underived words such as *chimney*, but they are prohibited word-finally, so orthographic *damn* is pronounced without the /n/ (cf. *damnation*, where /n/ is pronounced). In Class 2 affixation, however, /n/ deletes even before vowel-initial suffixes, as in *damning*. There are plenty of examples of this in English:

(11) English cluster simplification in class 1 and class 2 affixation (Borowsky 1986, Benua 1997)

OO-base	*Class 1 affix*	*Class 2 affix*
condem<n>	condemnation	condem<n>ing
dam<n>	damnation	dam<n>ing
lon<g>	elongate	lon<g>ing
stron<g>	strongest	stron<g>ly
resig<n>	resignation	resig<n>ing
crum<b>	crumble	crum<b>y
colum<n>	columnist	colum<n>ing

The intuition is that /n/ is left out of the affixed form to make the derived form, *dam<n>ing*, more similar to the corresponding output form *dam<n>*. In Benua's analysis, Class 2 affixes are subject to Dep-OO, which dominates Max-IO and requires /n/-deletion even in environments where it isn't conditioned. In this example, identity between surface forms that belong to the same paradigm overrides faithfulness to underlying forms.

Once again, this type of pattern does not lend itself to an analysis strictly in terms of markedness constraints. The analysis of overapplication must explain why the prohibition on [mn] is sensitive to morphological and paradigmatic information: *chimney* is okay, but **damning* is not. The generalization is that a cluster is prohibited from surfacing if one of its components lacks a correspondent in a morphologically related base. This is a matter of transderivational correspondence, not markedness, so a faithfulness constraint is needed.

6 Conclusion

In this squib, I have shown that Dep constraints have such a wide range of effects that it is overly simplistic to call them constraints against epenthesis. Dep constraints are instrumental in underapplication of deletion in reduplication and overapplication of deletion in non-reduplicative affixation. Dep constraints are a necessary member of the constraint set Con in OT—they cannot be supplanted by *Struc constraints, with which they have been claimed to be redundant. Far from being redundant, Dep constraints are irreplaceable.

For encouraging feedback and constructive suggestions on this and related work, I would like to thank Tuuli Adams, Lisa Davidson, Kathryn Flack, Nancy Hall, Shigeto Kawahara, Ania Łubowicz, Kyle Major, John McCarthy, Joe Pater, Kevin Roon, Jason Shaw, John Singler, Jennifer Smith, Lisa Zsiga, the audiences at UMass Amherst and NYU, and the two anonymous LI reviewers and Curt Rice.

Notes

[1]McCarthy and Prince (1995) propose Dep as part of their general theory of faithfulness, but they do not discuss any unambiguous cases where Dep-BR is decisive. In their analysis of Javanese *h*-deletion, the evidence is ambiguous—in the crucial cases, it is not clear whether the relevant prohibition is on insertion in the reduplicant or on the deletion in the base, since reduplication is near-total and it is impossible to identify which of the strings is the base and which is the reduplicant—information crucial for the purposes of reckoning Dep and Max violations (1995, pp. 38-39). They therefore propose two analyses: Dep-BR is crucially active in one, and Max-BR—in the other.

[2]Vowels delete in other contexts in Tonkawa, as well—for example, the first of two vowels in a sequence is deleted to avoid hiatus /picena-oʔ/ →[pic.noʔ] 'he hoes them,' and there is final vowel apocope /notoxo/→no.tox 'hoe.' These facts are not really relevant to reduplication; for a full analysis, see Gouskova (2003).

[3]Hoijer changed his transcription system for Tonkawa between 1933 and 1946; transcriptions from his earlier work have been modified according to the conventions he uses in 1949.

[4]I assume a more or less standard trochaic foot inventory (H́ and ĹL, Hayes 1995) with the addition of H́L (see Mellander 2003, Rice 1992).

[5]The tableau is in comparative format (Prince 2002). In comparative tableaux, each row presents a winner-loser pair, and for every constraint, the row shows whether it favors the winner (W) or the loser (L) in the comparison. A working tableau with a correct ranking will have a W dominating every L. Thus, Max-V prefers the faithful loser *not<u>o</u>xoʔ* over the vowel-deleting winner *notxoʔ*.

[6]There are a few unsystematic exceptions to this that do undergo syncope, but Hoijer is clear that the CV-CV pattern is the predominant one and that this is unexpected, given the general trend for second vowel syncope.

[7]Even though Dep-BR sometimes does the same work as the prohibition on geminates in Tonkawa, it cannot take over, because the constraint against geminates is never violated in the language even outside of the reduplication context. The prohibition on identical consonants is therefore needed under Richness of the Base to rule out geminates from the surface inventory.

[8]I would like to thank the editor and an anonymous reviewer for suggesting the first three of these alternative analyses.

[9]Beckman suggests in the footnote that prosodic markedness constraints such as Onset always dominate positional faithfulness, but extrinsic meta-rankings of this sort seem to be a stipulative way of avoiding undesirable predictions in OT. McCarthy (to appear) proposes a different solution in his version of OT: positional faithfulness constraints such as Ident-Onset[voice] refer to the syllabification in an intermediate stage of derivation rather than in the output form, which means that positional faithfulness can refer to syllabification but cannot affect it. McCarthy is explicit, however, on the point that only input-output mappings involve such intermediate derivational stages, so the problem of StRole (if such a constraint existed) is still not solved. If, as I argue, there are no constraints such as StRole, then there is no problem.

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