# Overapplication Conversion*

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This squib sheds light on the relationship between two types of overapplication opacity, counterbleeding and self-destructive feeding, by demonstrating how one can be formally converted into the other. This demonstration further clarifies the relation between self-destructive feeding and cross-derivational feeding interactions, which have also been identified as involving overapplication opacity (Baković 2007, 2011).
**Keywords:** overapplication, opacity, counterbleeding, self-destructive feeding, cross-derivational feeding

## The larger project

Our joint work (Baković and Blumenfeld 2016, 2017, to appear-a, to appear-b, in prep.) aims to formally characterize how phonological input-output maps (*qua* SPE-style rules) can be related to each other and thus how they can potentially interact with each other, building on very early work in generative phonology (Chafe 1968, Kiparsky 1968, Koutsoudas et al. 1974). One part of our project is to delimit the typology of possible pairwise map interactions, and another is to define the precise relationships between different known rule interactions. This squib is a contribution to the latter part of the project, focussing on a subset of established opaque interactions (Baković 2007, 2011) and conceived in the spirit of Ito and Mester (2003).

## 1 Introduction

We begin with necessary definitions of some terms as we use them throughout.

- The word *apply* is used to refer to non-vacuous, potential rule application. So, e.g. "$P$ applies to $a$" means simply that $P(a) \neq a$, whether or not $P$ actually applies to $a$ in the language under discussion (see fn. 1), and whether or not $a$ or $P(a)$ are actual forms in that language (see fn. 2).
- The word *input* (to $P$) is strictly used to refer to the undergoer of $P$'s non-vacuous application.
- The word *output* (of $P$) is strictly used to refer to the result of $P$'s non-vacuous application.

Now, consider the following interaction between an epenthesis rule and a deletion rule in Turkish.[1]

(1) Epenthesis self-destructively feeds deletion in Turkish
  a. **Epenthesis:** $\varnothing \longrightarrow i$ / C — C#
  b. **Deletion:** $k \longrightarrow \varnothing$ / V — V
  c. **Self-destructive feeding interaction:** *bebekn* $\xrightarrow{ep}$ *bebekin* $\xrightarrow{del}$ *bebein* 'your baby'

Epenthesis feeds deletion by supplying the second vowel necessary for the deletion of *k*. But this is not a typical, transparent feeding interaction: the deletion of the *k* in turn obscures the reason why the vowel was epenthesized in the first place. This is why Baković (2007) calls this type of rule interaction *self-destructive feeding*. Like counterbleeding, self-destructive feeding is an example of Kiparsky's (1973) 'type

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[1] All examples in this squib have been drastically simplified for entirely expository purposes. As an anonymous reviewer reminds us, our references to concrete language names (Turkish, Russian, Polish, English, and Cibaeño Spanish) should not be taken too literally; the actual data stand in for the more abstract types of interaction patterns that are our focus here.

(ii)’ opacity, which McCarthy (1999) rechristens *overapplication opacity*: one rule (in this case, epenthesis) appears to have applied in a context where it shouldn’t have (here, after a vowel instead of after a consonant) due to the subsequent, obscuring application of another rule (deletion). (See §4 for more discussion.)

Baković and Blumenfeld (2017) provide a formal framework for precisely characterizing the differences between rule interactions such as feeding, counterbleeding, and self-destructive feeding (henceforth ‘seeding’). In both feeding and seeding, an earlier rule $P$ crucially provides the input conditions for a later rule $Q$ to apply, but in the case of feeding, $P$ also potentially creates the same *outputs* as does $Q$. Consider in this regard the feeding interaction between deletion and devoicing in Russian.

(2) Deletion feeds devoicing in Russian

a. **Deletion:** [+lat] $\longrightarrow \varnothing$ / C __ #

b. **Devoicing:** [−son] $\longrightarrow$ [−voi] / __ #

c. **Feeding interaction:** *grebl* $\xrightarrow{del}$ *greb* $\xrightarrow{dvc}$ *grep* ‘he rowed’

Deletion crucially changes *grebl* to *greb*, providing the input conditions for devoicing to apply, resulting in *grep*. But deletion can also result in an output like *grep* directly, from (hypothetical) input *grepl*. We term this *output provision*: deletion output-provides devoicing. This is not the case with Turkish seeding (1): there is no possible input to which epenthesis can apply directly to render *bebein*.[2]

To fully appreciate the distinction between feeding and seeding, it is useful to also compare seeding to counterbleeding. In both counterbleeding and seeding, there is *output removal*: a later rule $Q$ changes the result of $P$’s application such that $Q$’s result is not among the possible (non-vacuous) outputs of $P$. In the case of counterbleeding, application of $P$ additionally does not crucially provide inputs to $Q$. Consider in this regard the counterbleeding interaction between raising and devoicing in Polish.

(3) Devoicing counterbleeds raising in Polish

a. **Raising:** *o* $\longrightarrow$ *u* / __ $\begin{bmatrix}\text{+voi}\\ \text{−nas}\end{bmatrix}$#

b. **Devoicing:** [−son] $\longrightarrow$ [−voi] / __ #

c. **Counterbleeding interaction:** *ʒwob* $\xrightarrow{rse}$ *ʒwub* $\xrightarrow{dvc}$ *ʒwup* ‘crib’

Devoicing changes *ʒwub* to *ʒwup*, destroying the input conditions that made it possible for raising to apply (from *ʒwob* to *ʒwub*) and thus creating a result that is not among the possible outputs of raising. This output removal is also found in the case of seeding in Turkish: deletion changes *bebekin* to *bebein*, destroying the input conditions that made it possible for epenthesis to apply and thus resulting in a form that is not among the possible outputs of epenthesis. But in the Polish counterbleeding case, devoicing is defined such that it could (hypothetically) apply directly to input *ʒwob*, changing it to *ʒwop*. This is not true in the case of seeding in Turkish: deletion cannot apply to *bebekn* unless epenthesis changes it to *bebekin*.

The following figures summarize the key similarities and differences among these three types of rule interaction. Figure 1 illustrates the situation for feeding: one rule (in this case, Russian deletion) crucially provides both inputs and outputs for another (devoicing). Because deletion both input-provides and output-provides devoicing, devoicing does not output-provide deletion. Figure 2 illustrates the situation for counterbleeding: one rule (Polish devoicing) crucially removes both inputs and outputs from another (raising). Because devoicing both input-removes and output-removes raising, raising does not input-remove devoicing. Finally, Figure 3 illustrates the situation for seeding: one rule (Turkish epenthesis) crucially

[2]Note that the existence or non-existence of an actual input like *grepl* in Russian has no bearing on the point just made. Rules are functions that are everywhere defined — for any possible input, a rule either produces an identical form or applies (non-vacuously) to produce something else. This means that in this example and others in this squib, we may consider input-output pairs that are abstract in the sense that they may not be found in the actual languages used as examples of the interactions of interest.

provides inputs for another rule (deletion), which in turn crucially removes outputs from the first. Seeding thus shares formal properties with both feeding (input-provision) and counterbleeding (output-removal), corresponding to its characterization as feeding with overapplication (Baković and Blumenfeld 2017).

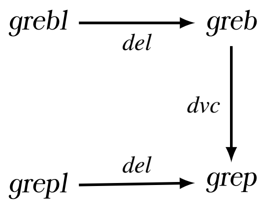


**Figure 1:** *del* feeds *dvc*

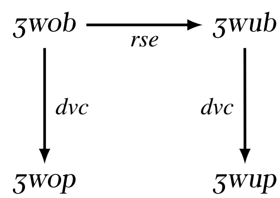


**Figure 2:** *dvc* counterbleeds *rse*

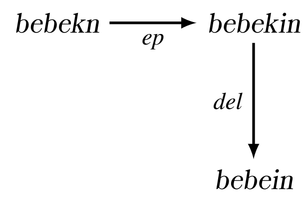


**Figure 3:** *ep* seeds *del*

A convention we follow in these figures is that the first of the two rules in the ordered-rule analyses sketched in (1)-(3) above is represented horizontally, with inputs on the left and outputs on the right, while the second rule is represented vertically, with inputs above and outputs below.

Note also that the absence of an arrow is as significant as its presence in these figures: it is crucial, for example, that there is no arrow connecting *grebl* and *grepl* in the feeding example in Figure 1. If there were such an arrow, i.e. if devoicing applied to pre-sonorant obstruents as well as word-finally, then there would be no feeding — and indeed, no interaction of any kind between deletion and devoicing.

More generally, as Baković and Blumenfeld (2017) argue, any pairwise rule interaction can be characterized as some combination of one of the four basic types of relations defined in (4) below. The innovation in our work that allows us to distinguish, e.g., seeding from feeding and counterbleeding, are the output interactions in (4c,d) which have not been considered in previous work.[3]

(4) Basic relations between rules

a. $P$ **input-provides** $Q$ if there are forms $a, b$ such that $P(a) = b$ and $Q$ applies to $b$ but not $a$.

b. $P$ **input-removes** $Q$ if there are forms $a, b$ such that $P(a) = b$ and $Q$ applies to $a$ but not $b$.

c. $P$ **output-provides** $Q$ if there are forms $a, b$ such that $P(a) = b$ and there exists a form $c$ such that $Q(c) = b$ but there does not exist a form $d$ such that $Q(d) = a$.

d. $P$ **output-removes** $Q$ if there are forms $a, b$ such that $P(a) = b$ and there exists a form $c$ such that $Q(c) = a$ but there does not exist a form $d$ such that $Q(d) = b$.

## 2 Conversion

Assuming that $P$ is the first and $Q$ is the second rule in the ordered-rule analyses, feeding as in Russian (2) is $\{P$ input-provides $Q$, $P$ output-provides $Q\}$, counterbleeding as in Polish (3) is $\{Q$ input-removes $P$, $Q$ output-removes $P\}$, and seeding as in Turkish (1) is $\{P$ input-provides $Q$, $Q$ output-removes $P\}$. These interactions are thus defined by the structure of the mappings illustrated in Figures 1–3.

A consequence of this is that one type of interaction can — abstractly, if not concretely — be *converted* into another by adding or removing a mapping, as represented by an arrow in the diagram. For example, taking seeding as a starting point, adding a downward arrow originating in *bebekn* will yield the counterbleeding structure, while adding a leftward arrow that ends at *bebein* will yield the feeding structure. Note that this conversion operation is not (necessarily) grammar-preserving: its purpose is simply to illustrate the formal connections between various types of interactions, and to uncover their hidden commonalities. After introducing the operation, in the following subsection, we will uncover such a commonality between counterbleeding and another interaction called *cross-derivational feeding* (Baković 2007, 2011).

[3]These definitions are somewhat simplified here, in that they do not cover certain types of cases where e.g. there is more than one locus of application of a rule in a form. For a more formally comprehensive account, see Baković and Blumenfeld (in prep.).

### *2.1 Converting Russian feeding to seeding*

In the rule formalism of *SPE* (Chomsky and Halle 1968), these mappings can be excised or added via judicious rule re-writing. For example, in order to convert the Russian feeding example in (2) to seeding, we can specify that the consonant in the environment of deletion (2a) must be voiced, as in (5).

(5) **Modified deletion:** $[+\text{lat}] \longrightarrow \varnothing \;/\; \underset{[+\text{voi}]}{\text{C}}\, \_\_\, \#$

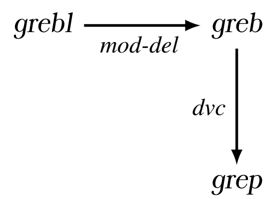


**Figure 4:** *mod-del* seeds *dvc*

This successfully excises the output-providing *grepl* $\xrightarrow{del}$ *grep* mapping from Figure 1 that differentiates this case of feeding from seeding: removal of a lateral after a voiced obstruent exposes that obstruent to devoicing, which in turn obscures the reason for the removal of the lateral. But of course, the resulting seeding interaction does not generate the same overall input-output map as the original Russian feeding interaction in (2): final laterals preceded by **any consonant** are deleted in Russian, but only laterals preceded by **voiced consonants** are deleted if we substitute the modified version of deletion in (5) for (2a).

As an anonymous reviewer points out, it could also be questioned whether the modified deletion rule in (5) is 'natural' (e.g., phonetically motivated), and the same can be said for the other modified rules contemplated for Polish and Turkish in the subsections below. Our focus here is on the *formal relationships* between different abstract types of rule interactions, not on the *substantive differences* between different particular tokens of rules; whether a rule rewritten for the purposes of conversion is 'natural' — or '*as* natural' as the original rule — is beside the point; but see §3 for some further discussion of this issue.

### *2.2 Converting Polish counterbleeding to seeding*

Rule re-writing is not always achievable in practice, given the limitations of (specific theories of) natural class descriptions. For example, in order to convert the Polish counterbleeding example to seeding, we need to excise the input-removing *ʒwob* $\xrightarrow{dvc}$ *ʒwop* mapping from Figure 2 that differentiates this case of counterbleeding from seeding. We can achieve this excision by specifying that the vowel preceding the obstruent target of devoicing (3b) must not be *o*, but there is no clear way of accomplishing this in most if not all distinctive feature theories except in the most *ad hoc* of ways, as in (6).

(6) **Modified devoicing:** $[-\text{son}] \longrightarrow [-\text{voi}] \;/\; \underset{\neg o}{\text{V}}\, \_\_\, \#$

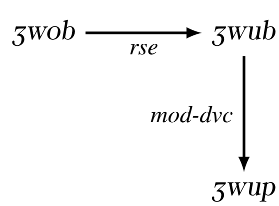


**Figure 5:** *rse* seeds *mod-dvc*

This challenge of formalism aside, the resulting interaction in this case *does* generate the same overall input-output map as the original counterbleeding interaction in (3) because final voiced obstruents preceded by *o* don't (directly) undergo devoicing either way. With the original devoicing rule in (3b), potential inputs to mappings like *ʒwob* $\xrightarrow{dvc}$ *ʒwop* all undergo raising instead (*ʒwob* $\xrightarrow{rse}$ *ʒwub*) because raising precedes devoicing; the result is only subsequently devoiced (*ʒwub* $\xrightarrow{dvc}$ *ʒwup*). The only difference with the modified version of devoicing in (6) is that there is no need to rely on the prior application of raising to prevent *ʒwob* from undergoing devoicing; the conversion to seeding has no empirical effect.

### *2.3 Converting Turkish seeding to feeding or counterbleeding*

To convert the Turkish case of seeding to feeding, we need to add to Figure 3 the output-providing mapping *beben* $\xrightarrow{ep}$ *bebein*, which means that the epenthesis rule in (1a) needs to be re-written as in (7).

(7) **Modified epenthesis:** $\varnothing \longrightarrow i$ / — C#

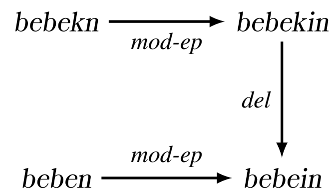


**Figure 6:** *mod-ep* feeds *del*

To convert the Turkish case to counterbleeding, we instead need to add the input-removing mapping *bebekn* $\xrightarrow{del}$ *beben* to Figure 3, which means that the deletion rule in (1b) needs to be re-written as in (8).

(8) **Modified deletion:** $k \longrightarrow \varnothing$ / V —

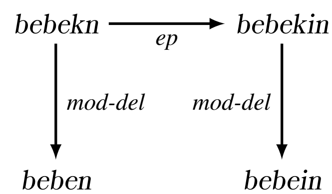


**Figure 7:** *mod-del* counterbleeds *ep*

As in the Russian example, the resulting interaction given either of these conversions does not generate the same overall input-output map as the original seeding interaction in (1). In Turkish, *i* is epenthesized **between pairs** of word-final consonants; the modified version of epenthesis in (7) more generally epenthesizes *i* **before any single** word-final consonant. Similarly, *k* is deleted **between pairs** of vowels in Turkish; the modified version of deletion in (8) more generally deletes *k* **after any single** vowel.

### *2.4 Summary*

Any feeding or counterbleeding interaction can be converted to seeding by excising a relevant mapping: an output-provision one in the case of feeding or an input-removal one in the case of counterbleeding. The same is of course true in the opposite direction, *mutatis mutandis*: seeding can be converted to feeding by adding an output-provision mapping, or to counterbleeding by adding an input-removal mapping.

The relative ease or lack of ease with which conversion can be achieved is entirely a property of the formalism in which the maps are expressed rather than of the maps themselves, and it is independent of the particular type or direction of conversion. This is clear from the comparison between Polish and Turkish: if the interaction we had started from in the Turkish example were the counterbleeding interaction illustrated in Figure 7, the conversion to seeding would involve excision of the input-removal mapping just as in the Polish example; the formalism allows this to be expressed easily in the case of Turkish, but not in the case of Polish. The observation about the relationship between types of interactions is formalism-neutral.

Finally, the result of conversion may or may not result in the same overall input-output map as the original. This also appears to be independent of the particular type or direction of conversion: if the interaction we had started from in the Turkish example were the counterbleeding interaction illustrated in Figure 7, the conversion to seeding would involve excision of the input-removal mapping just as in the Polish example; the result is grammar-preserving in the case of Polish, but not in the case of Turkish.

## 3 From bleeding to cross-derivational feeding

Conversion via mapping excision or addition is just one way to convert one type of interaction into another. As is well-known from the rule-ordering literature, feeding and counterfeeding can be converted into one another via rule re-ordering; likewise for bleeding and counterbleeding.[4] Here we discuss a specific case of a bleeding interaction, change it to counterbleeding via rule re-ordering, and then convert that counterbleeding interaction into seeding via excision of the input-removal mapping, as we did in the case of Polish.

Like the Polish case, the overall map generated by counterbleeding and by seeding is the same. Unlike the Polish case, however, the modified rule is formally unremarkable, and the modification corresponds to the structural description of the rule necessary for a *cross-derivational feeding* analysis of the map generated by the original bleeding interaction (Baković 2005, 2007, 2011, Pająk and Baković 2010). This is of formal interest given the claim made by Baković (2007) that cross-derivational feeding, like counterbleeding and seeding, involves overapplication opacity, even though the map generated by cross-derivational feeding is the same as the one generated by (transparent) bleeding, as discussed in more detail in §4.

### *3.1 From bleeding to counterbleeding*

Consider now the bleeding interaction (9c) between epenthesis (9a) and assimilation (9b) in the English past tense alternation, which we can convert to counterbleeding (9d) via rule re-ordering.[5]

(9) Epenthesis bleeds assimilation in English

a. **Epenthesis:** $\varnothing \longrightarrow \text{ə} \;/\; \begin{bmatrix} \text{+cor} \\ -\text{son} \\ -\text{cont} \end{bmatrix} \;\_\_\; \begin{bmatrix} \text{+cor} \\ -\text{son} \\ -\text{cont} \end{bmatrix} \#$

b. **Assimilation:** $[-\text{son}] \longrightarrow [\alpha\text{voi}] \;/\; \begin{bmatrix} -\text{son} \\ \alpha\text{voi} \end{bmatrix} \;\_\_\; \#$

c. **Actual bleeding interaction:** *hitd* $\xrightarrow{ep}$ *hitəd* $\xrightarrow{asm}$ *hitəd* ‘heated’

d. **Hypothetical counterbleeding interaction:** *hitd* $\xrightarrow{asm}$ *hitt* $\xrightarrow{ep}$ *hitət*

The epenthesis rule (9a) is stated such that it applies between final sequences of coronal stops; that is, to the set of input substrings {*td#*, *tt#*, *dt#*, *dd#*}. The fact that this rule specifically ignores possible differences in voicing between the two coronal stops is necessary for the bleeding interaction (9c) to effect the actual English input-output mappings: epenthesis must have priority to apply to the input substring *td#*; assimilation (9b) is also applicable to this substring, but does not in fact apply to it. For the hypothetical counterbleeding interaction (9d), however, epenthesis effectively applies only between final sequences of *identical* coronal stops, {*tt#, dd#*}, because the prior application of assimilation ensures that the voicing-wise distinct sequences {*td#, dt#*} are mapped to the completely identical sequences {*tt#, dd#*}.

[4]Hein et al. (2014) also propose a *rule flipping* operation that converts between (counter)feeding and (counter)bleeding. See Baković and Blumenfeld (to appear-b) for more extensive discussion of all three of these conversion operations.

[5]Vaux and Myler (2018: 180-181), citing Anderson (1973), claim that dialects of English consistent with this counterbleeding interaction exist; Vaux (2016) reports on a follow-up confirmation of their existence via a query on Facebook. The present authors are skeptical and await properly controlled phonetic verification, though nothing in the following relies on the result.

### *3.2 From counterbleeding to seeding*

This means that, as far as the hypothetical counterbleeding interaction (9d) goes, the epenthesis rule can be innocuously re-written as (10). This modification excises the input-removing mapping *hitd* $\xrightarrow{ep}$ *hitəd*, which effectively converts the counterbleeding interaction (Figure 9) into seeding (Figure 10).[6]

(10) **Modified epenthesis:** $\varnothing \longrightarrow$ ə / $\begin{bmatrix} +\text{cor} & -\text{son} \\ -\text{cont} & \alpha\text{voi} \end{bmatrix}$ — $\begin{bmatrix} +\text{cor} & -\text{son} \\ -\text{cont} & \alpha\text{voi} \end{bmatrix}$#

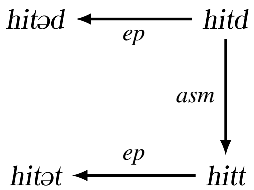


**Figure 8:** *ep* bleeds *asm*

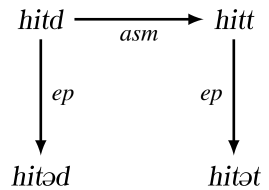


**Figure 9:** *ep* counterbleeds *asm*

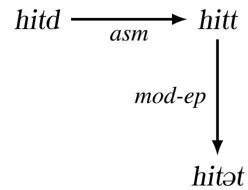


**Figure 10:** *asm* seeds *mod-ep*

### *3.3 From seeding to cross-derivational feeding*

The addition of [$\alpha$voi] to the original epenthesis rule (9a) to create the modified epenthesis rule (10) allows us to generalize the structural description of this rule to (11), where '$C_\alpha$' is a shorthand for 'consonant that shares all the same features with another $C_\alpha$'.

(11) **Generalized epenthesis:** $\varnothing \longrightarrow$ ə / $C_\alpha$ — $C_\alpha$#

Baković (2005) argues that this generalized structural description is the right one for the analysis of the actual English facts in OT (Prince and Smolensky 2004). Satisfaction of a markedness constraint with this structural description — NoGem in Baković (2005) — as well as of the markedness constraint responsible for assimilation — Agree(voi) — ensures that, from input *hitd*, epenthesis (*hitəd*) is better than both the faithful candidate (*hitd*) and assimilation (*hitt*), and also better than both epenthesis and assimilation (*hitət*), which gratuitously violates Ident(voi). This type of interaction is called *cross-derivational feeding* (henceforth *cd-feeding*), alluding to the fact that explicit consideration of the mistaken derivational path with assimilation *hitd* $\xrightarrow{asm}$ *hitt* is crucial to finding the correct derivational path with epenthesis *hitd* $\xrightarrow{gen\text{-}ep}$ *hitəd*.[7]

(12) Assimilation cd-feeds epenthesis in English

| *hitd* | $\mathbb{M}_2$:NoGem | $\mathbb{M}_1$:Agree(voi) | $\mathbb{F}_2$:Dep-V | $\mathbb{F}_1$:Ident(voi) | *Remarks* |
|---|---|---|---|---|---|
| *hitd* | | * ! | | | *faithful* |
| *hitt* | * ! | | | * | *assimilation* |
| ☞ *hitəd* | | | * | | *epenthesis* |
| *hitət* | | | * | * ! | *both* |

[6] The original bleeding interaction is also illustrated in Figure 8 for completeness. It is technically identical to counterbleeding in terms of the formal relationships between the two rules, but given the convention noted toward the end of §1 that the first rule in an order is represented horizontally and the second rule is represented vertically, the rule re-ordering operation amounts to a 90°-rotation of the figure. See Baković and Blumenfeld (to appear-b) for more details on all of these operations.

[7] Note that this would still be cd-feeding if NoGem were replaced by a more specific constraint with the structural description of the modified epenthesis rule in (10). The generalization to (11) simply motivates the pursuit of the cd-feeding analysis further.

Here is another view on the information in (12). Given the bottom-rank of IDENT(voi) (= $\mathbb{F}_1$), the generally preferred way to satisfy undominated AGREE(voi) (= $\mathbb{M}_1$) is to assimilate. But, in the case of input *hitd*, assimilation leads to *hitt*, with a pair of adjacent identical consonants, violating equally undominated NOGEM (= $\mathbb{M}_2$). The candidate with epenthesis, *hitəd*, is thus preferred instead, avoiding violation of both $\mathbb{M}_1$ and $\mathbb{M}_2$ via violation of mid-ranked DEP-V (= $\mathbb{F}_2$). The candidate with both epenthesis and assimilation, *hitət*, violates both $\mathbb{F}_1$ and $\mathbb{F}_2$, and is dispreferred due to the gratuitous violation of $\mathbb{F}_1$.

A diagram for cd-feeding, similar to the ones shown before, is given in Figure 11; the squiggly arrows highlight the crucial assimilation and modified epenthesis path from *hitd* through *hitt* to *hitət* that results in the selection of the direct, non-gratuitous path (dotted) — corresponding to the structural description of no rule or constraint in the analysis — from *hitd* to *hitəd.* This cd-feeding diagram resembles in key respects the seeding diagram in Figure 10, repeated here for convenience of comparison.

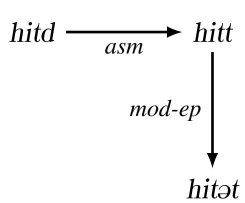


**Figure 10:** *asm* seeds *mod-ep*

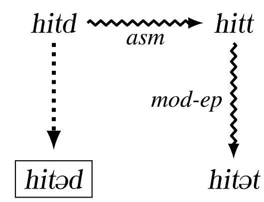


**Figure 11:** *asm* cd-feeds *mod-ep*

The resemblance between seeding and cd-feeding can perhaps be better appreciated via consideration of a final example: the interaction between gliding and deletion in Cibaeño Spanish, which Baković (2007) classifies both as an example of seeding (13) and as an example of cd-feeding (14).

(13) Gliding seeds deletion in Cibaeño Spanish

a. **Gliding:** $\left\{\begin{matrix} r \\ l \end{matrix}\right\} \longrightarrow j \,/\, \_\_ \left\{\begin{matrix} \mathrm{C} \\ \# \end{matrix}\right\}$

b. **Deletion:** $\mathrm{G}_\alpha \longrightarrow \varnothing \,/\, \mathrm{V}_\alpha \,\_\_$

c. **Self-destructive feeding interaction:** *silβo* $\xrightarrow{gld}$ *sijβo* $\xrightarrow{del}$ *siβo* 'I whistle'

(14) Gliding cd-feeds deletion in Cibaeño Spanish

| *silβo* | $\mathbb{M}_2$:NOV$_\alpha$G$_\alpha$ | $\mathbb{M}_1$:NOCODALIQUID | $\mathbb{F}_2$:MAX-C | $\mathbb{F}_1$:IDENT(cons) | *Remarks* |
|---|---|---|---|---|---|
| *silβo* | | * ! | | | *faithful* |
| *sijβo* | * ! | | | * | *gliding* |
| ☞ *siβo* | | | * | | *deletion* |

Unlike the English past tense case, the constraints in (14) match the structural descriptions of the rules in (13) exactly.[8] The reason this is possible in the case of Cibaeño Spanish is because of the nature of deletion: the winning deletion candidate in (14) does not distinguish whether it is the underlying liquid or the derived glide that has been deleted, thus conflating the alternative routes to deletion.[9] The diagrams for both analyses can thus be viewed as one and the same; this diagram is given in Figure 12.

[8] But note that if glides and corresponding high vowels are assumed to be featurally identical, the structural description of deletion ($\mathrm{V}_\alpha\mathrm{G}_\alpha$) can be assumed to correspond to something more like the more general NOGEM constraint used for English in (12) above. This is really neither here nor there, however, for the reasons already noted in footnote 7 above.

[9] Baković (2007: 254) conjectures that it has something to do with the Cibaeño Spanish case being an example of *feeding-on-focus* vs. the English case being an example of *feeding-on-environment*, but this now appears to be a secondary factor at best.

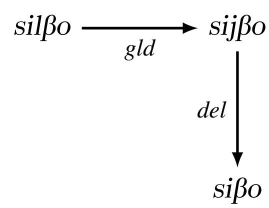


**Figure 12:** *gld* seeds / cd-feeds *del*

Clearly, then, seeding and cd-feeding are closely related types of interactions. Conversion from one to the other, when their empirical predictions differ as in the English case, can be accomplished via switching between a packaged-and-ordered rule system like *SPE* (for the result of the seeding analysis) and an unpackaged-and-ranked constraint system like OT (for the result of the cd-feeding analysis). This re-emphasizes a point made by Baković (2007): seeding is in general not possible to model in OT, and cd-feeding is in general not possible to model in *SPE* — but when the empirical predictions of a seeding analysis in *SPE* and a cd-feeding analysis in OT converge, there is no distinction between seeding and cd-feeding in either of the two theoretical frameworks.[10]

## 4 Overapplication opacity

As noted in the introduction, counterbleeding and seeding share in common the fact that they both involve overapplication opacity. In the terms originally defined by Kiparsky (1971, 1973), both seeding and counterbleeding involve the surface result of the application of a rule in a context other than that authorized by the structural description of the rule. In the case of Turkish seeding, the overall map *bebekn* ⟶ *bebein* shows the surface result of the application of epenthesis, but because the *k* has been subsequently deleted, the epenthesized vowel is in a context other than that authorized by the structural description of the epenthesis rule. In the case of Polish counterbleeding, *ʒwob* ⟶ *ʒwup* shows the surface result of the application of raising, but because the *b* has been subsequently devoiced, the vowel has been raised in a context other than that authorized by the structural description of the raising rule.

McCarthy (1999) calls this kind of opaque rule application *non-surface-apparent*: the reasons for the application of one rule are not apparent on the surface due to the subsequent, obscuring application of another rule. McCarthy's terminology succinctly captures Kiparsky's (1973) characterization of overapplication ('type (ii)') opacity: 'A phonological rule $\mathbb{P}$ of the form $A \longrightarrow B \,/\, C \,\_\, D$ is OPAQUE if there are surface structures with [...] instances of $B$ derived by $\mathbb{P}$ that occur in environments other than $C \,\_\, D$.'

From the perspective of OT, which is in general unable to model overapplication opacity, what seeding and counterbleeding have in common is the fact that they both involve a *gratuitious violation* of faithfulness (McCarthy 1999, Baković 2007). In the case of Turkish seeding, the intended optimal candidate in the overall map *bebekn* ⟶ *bebein* evinces both epenthesis of *i* (violating DEP-V) to avoid final clusters and deletion of *k* (violating MAX-C) to avoid intervocalic velar stops, but violation of MAX-C alone (*bebekn* ⟶ **beben*) would have been sufficient to satisfy both markedness demands simultaneously. In the case of Polish counterbleeding, the intended optimal candidate in the overall map *ʒwob* ⟶ *ʒwup* both raises *o* to avoid *o* preceding final voiced non-nasals, in violation of IDENT(high), and devoices obstruents to avoid word-final voiced obstruents, in violation of IDENT(voi), but again, violation of IDENT(voi) alone (*ʒwob* ⟶ **ʒwop*) would have been sufficient to satisfy both markedness demands simultaneously.

With this as background, let's reconsider the cd-feeding analysis of English in (12). The gratuitous violation of faithfulness in this case is incurred by the last candidate, *hitət*, corresponding to the result of the counterbleeding analysis (Figure 9) or the seeding analysis (Figure 10) with both assimilation and

[10]Thanks to an anonymous reviewer for prompting us to clarify this point.

(modified) epenthesis applying. However, Baković (2007, 2011) argues that the winning candidate, *hitəd*, with epenthesis applying alone, should be properly construed as also involving overapplication opacity. The close relationships among counterbleeding, seeding, and cd-feeding identified in this squib bolster this argument, presented in abbreviated form in (15).

(15) Cross-derivational feeding involves overapplication opacity (Baković 2007, 2011)

a. Voice-disagreeing adjacent obstruents are generally best-repaired by assimilation.

b. Adjacent identical consonants are generally best-repaired by epenthesis.

c. In the subset of inputs where final obstruents differ *only* in voicing, the preferred assimilation repair results in adjacent identical consonants, to which epenthesis is predicted to apply.

d. Epenthesis applies alone instead. This application of epenthesis is not surface-apparent, since the obstruents between which the epenthetic vowel has been inserted are not identical.

As Baković and Blumenfeld (2017) more narrowly conclude for counterbleeding and seeding, what unites all three of these interactions formally is that they crucially involve output-removal, highlighted with red arrows in the following repeated diagrams.

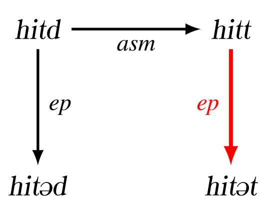


**Figure 9:** *ep* counterbleeds *asm*

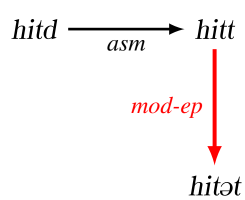


**Figure 10:** *asm* seeds *mod-ep*

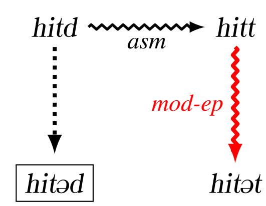


**Figure 11:** *asm* cd-feeds *mod-ep*

## 5 Concluding remarks

We hope to have demonstrated in this squib how three different types of overapplication opacity — counterbleeding, seeding, and cd-feeding — are formally closely related. Counterbleeding and seeding can each be converted into the other via a formal operation of excision or addition of an input-removing mapping; seeding and cd-feeding can each be converted into the other via switching between ordered rules and ranked constraints. This demonstration sheds light not only on the formal relationships among these types of overapplication opacity, but among different types of map interactions more generally.

One question left unanswered here is how to distinguish cases like Turkish, in which the conversion between counterbleeding and seeding results in differences in the overall input-output map generated, from cases like Polish and English, in which the same conversion results in no differences in the overall input-output map generated. We hope to find an answer to this question in our continued collaboration.

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