

Phonological opacity and counterfactual derivation*

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1 Introduction

It has become almost axiomatic that Optimality Theory (OT; Prince & Smolensky 1993/2004) is ill-suited for the treatment of opacity, the relevant sense of which is defined in most recent work (e.g., McCarthy 2002:165), following Kiparsky (1973:79), as follows:

- (1) A phonological process P of the form $A \rightarrow B / C_D$ is *opaque* if there are surface structures with either of the following characteristics:
 - a. instances of A in the environment C_D .
 - b. instances of B derived by P that occur in environments other than C_D .

McCarthy (1999) introduces helpful terminology to distinguish the two subcases in (1). Cases of type (1)a are examples of processes whose generalizations are *non-surface-true*, and cases of type (1)b are examples of processes whose generalizations are *non-surface-apparent*. McCarthy also demonstrates that there are in fact some kinds of non-surface-true generalizations that OT has no particular problem with at all: simple instances of contextual blocking (McCarthy 1999:332-333) and chain shifts (‘counterfeeding on focus’ as opposed to ‘counterfeeding on environment’ opacity; McCarthy 1999:363ff). McCarthy (1999:332) summarizes the situation for OT “[as it] is currently understood” as follows:

“Unless further refinements are introduced, OT cannot contend successfully with any non-surface-apparent generalisations nor with a residue of non-surface-true generalisations.”

My goal in this squib is to show that there exists an important class of heretofore unrecognized non-surface-apparent generalizations that, contrary to McCarthy’s assertion just above, can *only* be contended with successfully within OT — and without any further refinements. In a turnabout on the usual play, it is Derivational Phonology (DP) that must be significantly modified in order to properly capture this kind of generalization, giving the lie to the prevailing view that opacity as defined in (1) is a natural class of synchronically real phenomena with a unified analysis in DP in terms of rule ordering.¹

* I thank Sharon Rose and Paul Kiparsky for very helpful comments on an earlier draft of this squib, though neither of them should be held accountable for any remaining errors.

¹ I confine myself here to opaque interactions within a morphophonological level, taking it for granted that any attempt to derive an opaque generalization from the interaction of processes that apply at different levels, whether in DP or in OT, must be accompanied by independent motivation for the necessary levels and for the application of each process in its respective level.

The remainder of the squib is organized as follows. In §2, I review the familiar type non-surface-apparent generalization, counterbleeding opacity. In §3 I present the new type of non-surface-apparent generalization, counterfactual derivation, and how DP has problems with its analysis. In §0 I demonstrate how counterfactual derivation can be directly analyzed in OT. §5 consists of some concluding remarks.

2 Non-surface-apparent generalizations I: counterbleeding

Non-surface-apparent generalizations are familiarly exemplified by cases of counterbleeding opacity. In rule-ordering terms, counterbleeding may be defined as follows.²

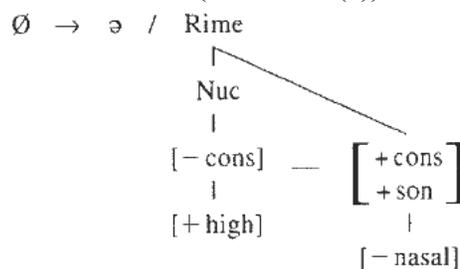
- (2) A rule *R* counterbleeds another rule *P* with respect to the derivation of a form *F* iff:
- a. *P* is ordered before *R*,
 - b. both *P* and *R* can and do apply (nonvacuously) to *F*, and
 - c. if the order of *P* and *R* were reversed, *R* would apply to *F* and would remove some necessary condition(s) for the subsequent application of *P* to *F* (that is, *R* would bleed *P*).

The generalization expressed by rule *P* in this definition is non-surface-apparent, since the later application of *R* removes some necessary condition(s) that were necessary for the prior application of *P*. Thus, if *P* were the rule $A \rightarrow B / C_D$, there would be surface-structure instances of *B* derived by *P* that occur in environments other than C_D because *R* is a rule that crucially alters those environments.

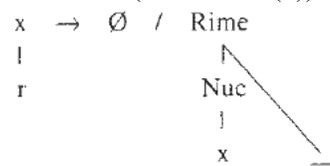
Several actual examples of counterbleeding have been rehearsed over and over in the recent literature; rather than attempt to contrive a new example here, I will choose one that I am most familiar with: the counterbleeding interaction between schwa insertion and *r*-deletion in Eastern Massachusetts English, addressed most specifically by McCarthy (1991), Halle & Idsardi (1997), Orgun (2001), and Krämer (2005). In the rule-based analysis of Halle & Idsardi (1997:343), the relevant rules are stated as follows.³

- (3) *r*-deletion counterbleeds schwa insertion

- a. schwa insertion (= rule *P* in (2))



- b. *r*-deletion (= rule *R* in (2))



² Note that the condition in (2)b is meant to exclude cases of *mutual bleeding*; see Ito & Mester (2003) for discussion of why some such cases might also be thought to involve opacity, even though they are both surface-true and surface-apparent.

³ A typo in the original formulation of (3)a, which was stated to apply after [-high]-final nuclei, has been fixed here.

Schwa insertion (3)a applies between a [+high]-final nucleus and a liquid within the same rime (with subsequent resyllabification fixing up the result). Thus, a word like *feel* is underlyingly /fijl/, to which schwa insertion applies, eventually rendering surface [fijəl]. Schwa insertion also applies to underlying /fijr/ *fear*, rendering intermediate [fijər], but *r*-deletion also applies to this form to eventually render surface [fijə]. If these rules had applied in the opposite order to this form, *r*-deletion would have rendered [fij] from /fijr/, thus removing a necessary condition for the subsequent application of schwa insertion. In this way, *r*-deletion counterbleeds schwa insertion; in the /fijr/ → [fijə] mapping, the generalization expressed by schwa insertion is rendered non-surface-apparent by the later application of *r*-deletion.

Examples like this one are known to require special analysis in OT. Orgun (2001), for example, employs McCarthy's (1999) Sympathy Theory proposal for the analysis of this example; more recently, Krämer (2005) argues that this example is not a case of opacity after all, but rather that there is a direct *r* → ə mapping that is independent of schwa insertion before nondeleted liquids.⁴ Briefly, the reason that counterbleeding is problematic for OT is because markedness constraints apply to candidate surface representations only and there is no surface motivation for the counterbled process to apply; given that *r* must delete in the syllable rime, schwa insertion before *r* is gratuitous (and thus nonoptimal).

3 Non-surface-apparent generalizations II: counterfactual derivation

There is a second type of non-surface-apparent generalization which, to the best of my knowledge, has gone previously unnoticed as such. The best way to appreciate this type of generalization is to consider an example. In Lithuanian, the verbal prefixes /at/ and /ap/ surface with an epenthetic vowel — as [at^ji] and [ap^ji], respectively — if the initial consonant of the stem is either identical to the prefix-final consonant or differs from it only in terms of voicing or palatalization (or both). Some key examples are given in (4).⁵

- (4) Lithuanian verbal prefix vowel epenthesis
- | | | | |
|--|------------------------|---|---------------------|
| at ^j i-t ^j eis ^j t ^j i | ‘to adjudicate’ | ap ^j i-put ^j i | ‘to grow rotten’ |
| at ^j i-duot ^j i | ‘to give back, return’ | ap ^j i-b ^j er ^j t ^j i | ‘to strew all over’ |
| cf. at-ko:p ^j t ^j i | ‘to rise, climb up’ | cf. ap-kal ^j b ^j et ^j i | ‘to slander’ |

As argued in Baković (to appear), the fact that vowel epenthesis appears to ignore differences in both voicing and palatalization is not accidental: the first of two adjacent consonants independently assimilates to the second in terms of voicing and palatalization in these (and other) contexts, as shown in (5) below.

⁴ Note that this sort of analysis was originally proposed by Pater (1999), where the counterbleeding order between nasal place assimilation and voiceless stop deletion in Austronesian is analyzed as coalescence of the nasal and voiceless stop: $n_1 + p_2 \rightarrow m_{1,2}$.

⁵ Lithuanian data drawn from Dambriunas *et al.* (1966), Mathiassen (1996), and Ambrazas (1997). The standard textbook example of English regular past tense and plural suffix allomorphy is the same as the Lithuanian example described here in all relevant respects; see Baković (2004, to appear) and Baković & Kilpatrick (2005) for further discussion.

the later application of assimilation is blocked in precisely those nearly-identical contexts, because only in those contexts would it counterfactually create pairs of completely identical adjacent consonants.

The paragraph just before Odden’s statement of the epenthesis rule betrays this weakness of the analysis: “Lithuanian does not allow sequences of identical consonants, so to prevent such a result, an epenthetic vowel is inserted between homorganic obstruent stops” (Odden 2005:115). It is clear that the epenthesis rule as stated in (6)a misses the generalization that voicing is ignored not as an arbitrary function of the rule, but specifically due to its interaction with the assimilation rule in (6)b.

Clearly, then, the epenthesis rule should be stated such that it applies between adjacent identical consonants only, and the fact that an epenthetic vowel surfaces in a non-surface-apparent manner between relevant nearly-identical consonants must follow from some interaction between epenthesis and assimilation, presumably to be expressed in terms of rule ordering. As shown in (7), however, the right result cannot be gotten with either of the two possible orders between epenthesis (stated so as to apply between adjacent identical consonants only, as just discussed) and assimilation (still stated as in (6)b).

(7) Possible ordered interactions between epenthesis and assimilation

<p>a. Epenthesis precedes assimilation</p> <p>UR /ap-b^jer^jt^ji/ ‘to strew all over’</p> <p>Epen. <i>not applicable</i></p> <p>Assim. *[ab^j-b^jer^jt^ji]</p>	<p>b. Assimilation precedes epenthesis</p> <p>UR /ap-b^jer^jt^ji/ ‘to strew all over’</p> <p>Assim. [ab^j-b^jer^jt^ji]</p> <p>Epen. *[ab^ji-b^jer^jt^ji]</p>
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Unlike counterbleeding, then, counterfactual derivation is not even able to be described, much less explained, in DP. The reason comes down to the fact that in DP the derivation of a form proceeds one step at a time and with limited possibilities for ‘looking back’ — e.g., nonderived environment blocking — or for ‘looking forward’ — e.g., blocking of the immediate output of a rule by a constraint (Kiparsky 1973). It isn’t clear precisely how DP should be modified in order to correctly express this sort of interaction, but it must be something along the following lines: the derivation of a form must be allowed to pursue a counterfactual path, the end result of which can serve as the motivation for the application of a rule in the “real” path of the derivation that leads to the actual surface form. In other words, separate candidate forms must be derived and compared, much as they are in OT; paraphrasing Halle & Idsardi (1997:337), this would be the conceptual equivalent of giving up on the enterprise of DP.

4 Counterfactual derivation in OT

In OT, the derivation of a form is computed by generating and comparing multiple complete derivations (= output candidates) of that form in parallel, typically all but one of which are counterfactual (= nonop-

timal). This fundamentally different property of OT uniquely allows for the kind of ‘looking forward’ that is needed in order to properly express counterfactual derivation.

The core constraints necessary for the analysis of the Lithuanian example discussed in §3 are as given in (8) below. I ignore here certain necessary but contextually irrelevant refinements of the analysis: the direction of assimilation, for example, or the fact that voicing and palatalization assimilation are probably governed by separate markedness and faithfulness constraints. (As I have already been doing thus far, I also ignore the automatic palatalization of the prefix consonant before the epenthetic high front vowel.)

- (8) Constraints for counterfactual derivation in Lithuanian
- a. NO-GEM, a markedness constraint penalizing adjacent identical consonants.
 - b. AGREE(voi/pal), a markedness constraint penalizing adjacent consonants that differ in their values of voicing/palatalization.
 - c. DEP-V, a faithfulness constraint against vowel epenthesis.
 - d. IDENT(voi/pal), a faithfulness constraint against changes in voicing/palatalization from underlying form (input) to surface form (output).

In order to enforce epenthesis between adjacent identical consonants, NO-GEM must dominate DEP-V. The utility of this ranking is illustrated in the tableau in (9) below.

- (9) [ap^ji-put^ji] ‘to grow rotten’: epenthesis between adjacent identical consonants

Input: /ap-put ^j i/	NO-GEM	DEP-V
a.  [ap ^j i-put ^j i]		*
b. [ap-put ^j i]	* !	

In order to enforce assimilation between adjacent consonants differing in voicing/palatalization, AGREE(voi/pal) must dominate IDENT(voi/pal). This is illustrated in the tableau in (10) below.

- (10) [ad^j-b^jek^jt^ji] ‘to run up’: assimilation between adjacent disagreeing consonants

Input: /at-b ^j ek ^j t ^j i/	AGREE(voi/pal)	IDENT(voi/pal)
a.  [ad ^j -b ^j ek ^j t ^j i]		*
b. [at-b ^j ek ^j t ^j i]	* !	

All that is necessary in order to ensure epenthesis instead of assimilation in the case of adjacent consonants differing only in voicing and/or palatalization is to bring these two rankings together, with the two markedness constraints dominating both faithfulness constraints. (Note that DEP-V must furthermore dominate IDENT(voi/pal) in order to account for the fact that voicing/palatalization disagreement otherwise results in assimilation as in (10), not epenthesis.)

(11) [ap^ji-b^jer^jt^ji] ‘to strew all over’: epenthesis, not assimilation

Input: /ap-b ^j er ^j t ^j i/	NO-GEM	AGREE(voi/pal)	DEP-V	IDENT(voi/pal)
a. ☞ [ap ^j i-b ^j er ^j t ^j i]			*	
b. [ap-b ^j er ^j t ^j i]		* !		*
c. [ab ^j -b ^j er ^j t ^j i]	* !			

This is a completely straightforward OT analysis that properly describes the non-surface-apparent generalization in question. The necessary counterfactual derivation in which assimilation applies but epenthesis doesn’t is shown in (11)c; this candidate output fatally violates NO-GEM, the markedness constraint otherwise responsible for epenthesis. Remaining faithful in this case, as in (11)b, is of course not an option because that violates AGREE(voi/pal), the markedness constraint otherwise responsible for assimilation. The only remaining option is epenthesis, the opaque candidate output in (11)a.

As brought to my attention by Paul Kiparsky (p.c.), this analysis of counterfactual derivation requires not only that each of the interacting processes (in Lithuanian, epenthesis and assimilation) be independently motivated, but also that they co-exist on the same morphophonological level in order for the non-surface-apparent process (epenthesis) to have the necessary access to the counterfactual output of the other process (assimilation). The independent-motivation requirement is investigated in detail in Baković (to appear); the level-co-existence requirement is an interesting matter for future research.

5 Concluding remarks

What I hope to have shown in this squib so far may be summarized as follows. While DP has for some time been argued to be uniquely capable of describing all types of opaque generalizations, there exists a clear class of non-surface-apparent opaque generalizations that are not able to be described in terms of rule ordering. In order to describe this class of generalizations properly, DP needs to be supplemented with some mechanism of counterfactual derivation, a move amounting to something very much like candidate output comparison in OT. And while it must be conceded that OT cannot properly describe certain classes of non-surface-apparent opaque generalizations such as counterbleeding, the novel counterfactual derivation class described here follows naturally from the basic architecture of OT.

Also worthy of note is the fact that counterfactual derivation involves an interesting give-and-take between opacity and transparency. In terms of the Lithuanian example, if epenthesis did not apply between some consonants that are not completely identical — i.e., if it applied in a transparent, surface-apparent fashion — and if assimilation were blocked from creating adjacent identical consonants, then assimilation itself would be non-surface-true. The opacity of epenthesis thus contributes to the greater

transparency of assimilation. This is essentially a conspiracy, then (Kisseberth 1970): both assimilation and epenthesis apply, though the latter only in part, to avoid unassimilated consonant clusters. The fact that there is this trade-off between opacity and transparency therefore challenges Kiparsky's (1973:80-81) strong conclusion that conspiracies are an expected by-product of a tendency to reduce opacity:⁶

“The explanation of conspiracies is thereby reduced to the theory of opacity. The fact that [...] Languages tend to have conspiracies [...] follows from the more general fact that [...] Languages tend to have transparent rules.”

Finally, although I have largely pitched this squib as a response to the entrenched view that DP excels in a general area where OT flounders — a view shared by researchers on both sides of the aisle, so to speak — my ultimate goal in pursuing this line of investigation is in fact very different. My interest is in uncovering new linguistically significant generalizations, of which I believe counterfactual derivation is one. It seems unlikely that the significance of this generalization, or of others that have been the matter of focused research over the past decade, would be able to be appreciated if it weren't for the existence of the two competing frameworks, DP and OT, each of which necessarily frames the data somewhat differently and generates a wealth of independent and interdependent research into phonological knowledge.

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⁶ On the other hand, counterfactual derivation appears to be a case of the type of conspiracy that Kiparsky (1973:78) describes this way: “a phonological rule can function as part of a conspiracy indirectly, by causing or preventing the application of other rules in conformity with the target.” I am unfortunately not aware of any other examples that can be so described.

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