**A revised typology of opaque generalizations*[*]*

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Abstract

This paper is about opaque interactions between phonological processes in the two senses defined by Kiparsky (1971, 1973) and discussed in much recent work on the topic, most notably McCarthy (1999): *underapplication* opacity, whereby a process appears to have failed to apply in expected contexts on the surface, and *overapplication* opacity, whereby a process appears to have applied in unexpected contexts on the surface. Specifically, I demonstrate that there are three distinct types of overapplication opacity in addition to the only case discussed and properly categorized as such in the literature, counterbleeding. The analysis of each type of opacity in terms of rule-based serialism and in terms of Optimality Theory is discussed, emphasizing the strengths and weaknesses of the two frameworks in each case.

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1 Obscured generalizations and the theory of opacity

Phonological generalizations can be partially obscured by their interactions with other phonological generalizations. In Optimality Theory (henceforth OT; Prince & Smolensky 1993/2004), the generalizations are expressed by ranked constraints, and a given constraint $\mathbb{C}$'s generalization is obscured in some environment *E* when $\mathbb{C}$ is outranked by another constraint that conflicts with $\mathbb{C}$ in environment *E*. In rule-based serialism (henceforth SPE; Chomsky & Halle 1968), the generalizations are expressed by ordered rewrite rules, and a given rule $\mathbb{R}$'s generalization is obscured in some environment *E* when $\mathbb{R}$ is ordered before another rule that rewrites any of the information crucially referenced by $\mathbb{R}$ in environment *E*.[1]

Because generalizations are expressed by different types of objects and their interactions in the two frameworks — constraints and ranking in OT, rules and ordering in SPE — different types of generalization obscurity are possible in each framework. There is some overlap, but some attested types of obscured generalizations cannot be expressed with rules and ordering alone, which is a problem for SPE, and other attested types cannot be expressed with constraints and ranking alone, which is a problem for OT.

Obscured generalizations of the type that is problematic for SPE constitute some of the original motivation for OT. In their discussion of blocking ('do something except when') effects, Prince & Smolensky (1993/2004) discuss how final syllable extrametricality is assigned in Latin except when the domain of stress assignment is monosyllabic. In SPE, this blocking effect can only be stated as an arbitrary exception to a rule of extrametricality assignment, unrelated to other aspects of prosodic structure.[2] By contrast, in OT the blocking effect follows from the ranking of two independently-motivated constraints: LX≈PR, requiring that every lexical word be prosodified and thus stressed, ranked above NONFINALITY, requiring that final syllables not be parsed in (the head of) the head foot. This blocking interaction is shown in (1).

(1) Blocking of extrametricality by monosyllables in Latin

Input: /mens/	LX≈PR	NONFINALITY
a. ⟨mens⟩	* !	
b. ☞ [(méns)]		*

[1] I set aside here 'mixed' frameworks involving both rules (more broadly, serial derivations) and constraints, as well as frameworks in which rules interact in ways other than ordering or in which constraints interact in ways other than ranking. This entails that I assume, for the sake of argument, that none of the interactions discussed here apply across lexical-phonological levels. See Kiparsky (2000, forthcoming) and Bermúdez-Otero (2003, forthcoming), among others, who make a case for reducing the kinds of opaque generalizations that are problematic for 'classical' (i.e., parallel) OT to such cross-level interactions.

[2] One could appeal to a principle outside of SPE proper, such as the Elsewhere Condition, to achieve blocking in this case and others; see, e.g., Idsardi & Purnell (1997:154, fn. 10), but see Baković (2006, to appear) on the inadequacies of this principle.

Obscured generalizations of the type that is problematic for OT have received pointed attention in more recent work, much of it as a negative response to the emergence of OT. This work typically makes specific reference to Kiparsky's (1971:621-622, 1973:79) surface diagnostics for obscured rule (= opaque process) generalizations, reproduced in (2) below. The substantive hypothesis behind Kiparsky's work in this area was that opaque generalizations are harder to learn than other, transparent generalizations. This was meant to explain Kiparsky's observation that there are examples of opacity that tend to become transparent over time for no apparent reason other than the opacity of the diachronically prior stages.[3]

(2) A process ℙ of the form $A \rightarrow B / C\_\_D$ is *opaque*
to the extent that there are surface representations of the form:
a. *A* in the environment *C__D*, or [= *non-surface-true / underapplication opacity*]
b. *B* derived by ℙ in environments other than *C__D*.[4] [= *non-surface-apparent / overapplication opacity*]

The italicized terms in brackets are due to McCarthy (1999). If there are surface instances of *A* in the environment *C__D*, as in (2)a, then the generalization expressed by ℙ — that *A* should always become *B* in the environment *C__D* — is not true of the surface; hence, 'non-surface-true'. It's as if ℙ had not applied everywhere it should; hence, 'underapplication'. If there are surface instances of *B* derived by ℙ that occur in environments other than *C__D*, as in (2)b, then the generalization expressed by ℙ — that *A* should become *B* only in the environment *C__D* — is not apparent from the surface; hence, 'non-surface-apparent'. It's as if ℙ had applied in places where it shouldn't; hence, 'overapplication'.

In SPE, opacity of both types arises from a rule ℚ ordered after the rule corresponding to the process ℙ. Underapplication (2)a typically corresponds to COUNTERFEEDING rule orders, where ℚ creates strings to which ℙ could apply (ℚ potentially *feeds* ℙ), but because ℙ is ordered before ℚ, the generalization expressed by ℙ is not true of the surface strings of the language. Likewise, overapplication (2)b typically corresponds to COUNTERBLEEDING rule orders, where ℚ destroys strings to which ℙ could apply (ℚ potentially *bleeds* ℙ), but because ℙ is ordered before ℚ, the generalization expressed by ℙ is true of the surface strings of the language but the reasons for ℙ's application are not apparent from those surface strings.

[3] There are examples of transparency that become opaque over time; these would have to be due to something that can override considerations of opacity. For example, Kiparsky's (1968) examples of bleeding orders that become counterbleeding orders were attributed to a "condition that allomorphy [within a paradigm] tends to be minimized" (Kiparsky 1971:626; see also p. 596*ff*).

[4] The 'derived by ℙ' bit here was added by Kiparsky (1973:79). The original definition without this bit in Kiparsky (1971:622) was judged to be "too simplistic, even given what little we now know about language acquisition and language change." With respect to the residue of cases covered by the 1971 definition (*B* not derived by ℙ in an environment other than *C__D*), Kiparsky (1973:79) writes that "it seems reasonable to assume that no special learning difficulty should arise from this case."

Kiparsky (1973:79) also added a third diagnostic, *B* not derived by ℙ in the environment *C__D*, which defines neutralizations as opaque. Because neutralizations are known not to pose special problems for either SPE or OT, this diagnostic is set aside here, just as it is in most if not all other work on the topic (see e.g. McCarthy 1999:358).

Recent work has focused almost exclusively on how opacity is a formal problem for OT, the prevailing view being that opaque generalizations as defined in (2) are an established natural class of phenomena with a complete and unified analysis only within SPE.[5] Virtually absent from this discussion is research probing the diagnostics in (2) themselves, with the aim of gathering examples that unexpectedly match or do not match those diagnostics. The research reported in this article aims to fill this gap.

My first goal is to demonstrate that at least four distinct types of overapplication opacity as defined in (2)b are attested, three in addition to counterbleeding. Two of these three additional types of overapplication opacity are of particular interest precisely because they involve *feeding* orders in an SPE analysis, and feeding orders are prototypically transparent. To the best of my knowledge, none of these additional cases has been properly described and classified in previous work.

My second goal is to examine how these cases can be analyzed in SPE and in OT. The results of this examination challenge the prevailing view noted above. As it turns out, the essential tools of both frameworks (rules and ordering in SPE, constraints and ranking in OT) each have strengths and weaknesses when it comes to the analysis of overapplication opacity. This work thus builds on and refines some results of McCarthy (1999), where it was shown that not all examples of opacity as defined in (2) are problematic for OT. McCarthy (1999:332) summarizes the situation for OT "[as it] is currently understood" with respect to the analysis of opacity as follows:

> "Unless further refinements are introduced, OT cannot contend successfully with any non-surface-apparent generalisations [overapplication, (2)b] nor with a residue of non-surface-true generalisations [underapplication, (2)a]."

I argue that this conclusion is justified only to the extent that overapplication opacity consists solely of interactions that involve what in an OT analysis would be a gratuitous violation of a faithfulness constraint. Counterbleeding, as discussed by McCarthy and as reviewed in §3 below, is a case of this type. So is the first new type of overapplication opacity that I introduce in this article, the type that I call SELF-DESTRUCTIVE FEEDING and which is discussed in §4. Both counterbleeding and self-destructive feeding submit to relatively simple SPE analyses involving a specific order between two rules, while a successful OT analysis of either case requires the kinds of "further refinements" noted by McCarthy.

The second type of overapplication opacity presented here is what I call NONGRATUITOUS FEEDING, discussed in §5. As the name suggests, an OT analysis of nongratuitous feeding is possible because it does not involve a gratuitous faithfulness violation. Indeed, standardly accepted analyses of typical exam-

[5] Some recent work purports to show that certain examples of opacity are (e.g. Poliquin 2006) or are not (e.g. Sanders 2003) synchronically 'live' phenomena to begin with. Recent work by the research team of the Learnability Project at Indiana University documents cases of opacity that arise during the course of acquisition; see Barlow (in press), Part II of Dinnsen & Gierut (to appear), and references cited therein. (Many thanks to an anonymous reviewer for pointing to the relevance of this work.)

ples of nongratuitous feeding independently minimized the role of serial derivations in favor of representational constraint satisfaction in the 1980s and early 1990s, even before the advent of OT.

The third type of overapplication opacity uncovered in this article, CROSS-DERIVATIONAL FEEDING, is discussed in §6, This is perhaps the most interesting type because a successful analysis of it involves an unprecedented type of global interaction: a feeding relationship across separate potential derivations of the same form. This global interaction is similar though not identical to the type found in conspiracies, which are notoriously problematic for SPE (Kisseberth 1970) and not at all a problem for OT (Pater 1999, McCarthy 2002). Not surprisingly, then, an OT analysis of cross-derivational feeding is straightforward, and in this case it is SPE that requires further refinements in order to contend successfully with it.

A particularly informative class of process interactions that I call CONCEALED FREE RIDES are discussed in §7. I show that the SPE analysis of this subset of the more general class of 'free rides' (Zwicky 1970) are special cases of self-destructive feeding. Unlike the type of self-destructive feeding discussed in §4, however, a straightforward analysis of a concealed free ride is possible in OT — and, as it turns out, that analysis is another example of cross-derivational feeding. What makes concealed free rides even more interesting is how they differ from both self-destructive feeding and cross-derivational feeding: somewhat counterintuitively, neither process involved in a concealed free ride is opaque by either clause of the definition of opacity in (2). While this result appears to expose a flaw in the definition of opacity, I suggest instead that it reveals the limits of our current understanding of the substantive coherence of opaque generalizations, where more empirical work desperately needs to be done.

The discussion proceeds as follows. I briefly review in §2 the difference between the cases of underapplication that are unproblematic for OT and the "residue" of underapplication that presents a problem for the theory. This is followed in §§3–7 by discussion of each of the process interactions described above, and §8 summarizes and concludes.

2 Underapplication / counterfeeding

The "residue" of underapplication opacity that is not directly amenable to analysis in OT is what McCarthy (1999) calls COUNTERFEEDING-ON-ENVIRONMENT, as opposed to the type of underapplication opacity that is unproblematic in OT, COUNTERFEEDING-ON-FOCUS.[6] McCarthy's analysis of Bedouin Arabic furnishes examples of both types of underapplication opacity, as shown in (3).[7]

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[6] A third type of underapplication opacity is a 'Duke-of-York' derivation; see McCarthy (1999:375*ff*, 2003a) for discussion.

[7] The low vowel raising process implicated in both of the examples in (3) is also in a counterfeeding-on-environment relationship with a vowel epenthesis process splitting up word-final consonant clusters: /gabr/ → [gabur], *[gibur].

(3) Two types of underapplication opacity in Bedouin Arabic (McCarthy 1999)

a. counterfeeding-on-focus

UR	/katab/	
i → Ø / __ σ	*n/a*	= $\mathbb{P}$
a → *i* / __ σ	|kitab|	= $\mathbb{Q}$
SR	[kitab]	'he wrote'

b. counterfeeding-on-environment

UR	/badw/	
a → *i* / __ σ	*n/a*	= $\mathbb{P}$
G → V / C __ #	|badu|	= $\mathbb{Q}$
SR	[badu]	'Bedouin'

Without repeating too much of McCarthy's discussion, the distinction between these two examples amounts to the following. In the counterfeeding-on-focus case in (3)a, otherwise known as a chain shift, if the two rules involved were ordered such that $\mathbb{Q}$ precedes and thus feeds $\mathbb{P}$ then both rules would apply to the same segment. What is necessary in an OT analysis, then, is to establish that Ø ≻ *i* ≻ *a* in the relevant context (≻ = 'is more harmonic than'), and for the otherwise predicted transitivity of the *a* → *i* → Ø chain to be broken by a faithfulness constraint against the 'fell swoop' change *a* → Ø; see Orgun (1995), Kirchner (1996), Gnanadesikan (1997), and Moreton & Smolensky (2002) for relevant proposals.

In the counterfeeding-on-environment case in (3)b, on the other hand, if $\mathbb{Q}$ precedes and feeds $\mathbb{P}$ then both rules would again apply, but this time not to the same segment. $\mathbb{Q}$ instead crucially provides an environment in which $\mathbb{P}$ could apply. The problem for an OT analysis in this case is that, in order to break the transitivity of the *adw* → *adu* → *idu* chain, there would need to be a very complex faithfulness constraint against the 'fell swoop' change *adw* → *idu*, crucially involving more than just one segment. Such a complex constraint could be devised in the relatively unrestricted version of the theory of local constraint conjunction discussed by Moreton & Smolensky (2002); see McCarthy (1999:366) for discussion.[8]

In SPE, both cases submit to exactly the same analysis. The difference between them amounts to nothing more significant than the difference in the logical relationships between the strings acted on by the rules: both rules affect the same element in the counterfeeding-on-focus case in (3)a, and one rule affects the context of application of the other in the counterfeeding-on-environment case in (3)b. The consequences of the difference between (3)a and (3)b are thus only made clear by the attempt to analyze both cases in OT. This subclassification of underapplication opacity thus allows for a deeper understanding of opaque generalizations and of each theory's contribution to that understanding. For example, it may be that all cases of underapplication opacity indeed behave in the same basic way, as reflected in the SPE analysis, or it may be that counterfeeding-on-focus and counterfeeding-on-environment behave differently in specific, identifiable ways, as seems to be the case for OT.

[8] Alternative solutions involve far more substantive modifications to OT, such as sympathy (McCarthy 1999, 2003a), comparative markedness (McCarthy 2003b), targeted constraints (Wilson 2000, 2001), and candidate chain theory (McCarthy, to appear). Primarily for reasons of space, solutions couched in either of these more elaborate theories are not discussed in this article.

Coincidentally, a striking demonstration of the utility of this subclassification approach can be found in the work that led to the important shift from Kiparsky's (1968:200) original hypothesis that "[r]ules tend to shift into the order which allows their fullest utilization in the grammar", which favors feeding and counterbleeding orders, to Kiparsky's (1971:623) opacity hypothesis that "[r]ules tend to be ordered so as to become maximally transparent", which favors (certain) feeding and bleeding orders. As originally noted by Kenstowicz & Kisseberth (1971), there exist two different types of bleeding order: one in which a rule ℙ bleeds another rule ℚ because ℙ crucially changes the segment that ℚ would have applied to (which we might call 'bleeding-on-focus') and another in which a rule ℙ bleeds another rule ℚ because ℙ changes the environment that would have conditioned ℚ ('bleeding-on-environment'). Kenstowicz & Kisseberth provide evidence that examples of bleeding-on-environment are natural and diachronically stable, and argue that all of Kiparsky's (1968) evidence for favoring counterbleeding comes from examples of bleeding-on-focus. Kiparsky thus abandoned the original "fullest utilization" hypothesis, accounting for his previous examples otherwise (see footnote 3) and for the markedness of counterbleeding orders elsewhere with the definition of overapplication opacity in (2)b.

The subclassification approach is taken throughout this article in demonstrating the existence of several distinguishable types of overapplication opacity as defined in (2)b, and to examine the implications of their analysis in SPE and OT. We begin with the one well-known type of example, counterbleeding.

3 Counterbleeding

Counterbleeding rule interactions are the only cases of overapplication opacity discussed as such in the relevant literature. McCarthy's (1999) Yokuts example involves a counterbleeding interaction between long vowel lowering and closed syllable shortening shown in (4).

(4) Counterbleeding in Yokuts (McCarthy 1999)

UR	/ʔiliː+l/		
[+long] → [–high]	|ʔileːl|	= ℙ	*cf.* /ʔiliː+hin/ → [ʔileːhin] 'fans'
V → [–long] / __ C#	|ʔilel|	= ℚ	*cf.* /panaː+l/ → [panal] 'might arrive'
SR	[ʔilel]	'might fan'	

The long vowel lowering rule ℙ overapplies in this derivation: because the subsequent application of the closed syllable shortening rule ℚ shortens the lowered vowel, the motivation for lowering in the first place is not apparent on the surface. If the order between the two rules were switched, only closed syllable shortening ℚ would apply, bleeding long vowel lowering ℙ, and /ʔiliː+l/ would surface as *[ʔilil].

The OT analysis of each of the independent processes is straightforward. Long vowel lowering is due a markedness constraint against long high vowels, call it NO-LONG-HIGH, ranked above a faithfulness constraint against lowering the high vowel, IDENT(high). Since shortening would also satisfy NO-LONG-HIGH, a faithfulness constraint against shortening (MAX-μ) must also be ranked above IDENT(high).

(5) Long vowel lowering = ℙ

Input: /ʔiliː+hin/	NO-LONG-HIGH	MAX-μ	IDENT(high)
a. [ʔiliːhin]	* !		
b. ☞ [ʔileːhin]			*
c. [ʔilihin]		* !	

Closed syllable shortening, on the other hand, is due to a markedness constraint against long vowels in closed syllables, call it NO-LONG-CLOSED, ranked above MAX-μ. Since lowering would in this case *not* be a way to satisfy NO-LONG-CLOSED, the fact that MAX-μ is ranked above IDENT(high) is irrelevant.

(6) Closed syllable shortening = ℚ

Input: /panaː+l/	NO-LONG-CLOSED	MAX-μ
a. [panaːl]	* !	
b. ☞ [panal]		*

The problem for OT is the counterbleeding interaction between the two processes illustrated in (4). Both processes apply — that is, both faithfulness constraints are violated — but the application of only one of them is all that is strictly necessary to satisfy the two markedness constraints. Specifically, shortening in a closed syllable alone (that is, violation of MAX-μ) would satisfy both NO-LONG-HIGH as well as NO-LONG-CLOSED. The additional application of long vowel lowering — more specifically, the additional violation of IDENT(high) — appears to be gratuitous in this case. This is shown in (7).

(7) Failure of counterbleeding in OT (intended optimal candidate indicated with '⊗')

Input: /ʔiliː+l/	NO-LONG-HIGH	NO-LONG-CLOSED	MAX-μ	IDENT(high)
a. [ʔiliːl]	* !	* !		
b. [ʔileːl]		* !		*
c. ☞ [ʔilil]			*	
d. ⊗ [ʔilel]			*	* !

The faithful candidate in (7)a incurs fatal violations of both markedness constraints. The lowering candidate in (7)b successfully fends off violation of NO-LONG-HIGH but not of NO-LONG-CLOSED. Since the shortening candidate in (7)c takes care of both markedness violations, application of both lowering and shortening in the actual output (7)d is unnecessary. There is no reason for lowering to overapply here.

A rather direct way to address this problem in OT is to concoct a complex constraint that specifically penalizes the shortening-only candidate in (7)c — e.g., a constraint against shortened high vowels — and to have it dominate IDENT(high). Local conjunction (Smolensky 1993, 1995, 1997) provides the means for such a constraint, which would be a conjunction of markedness and faithfulness: NO-HIGH $\&_l$ MAX-μ. (Such local conjunctions were originally employed by Łubowicz (2002) in the analysis of derived environment effects, and later by Ito & Mester (2003) in the analysis of counterbleeding and certain mutual bleeding interactions that are otherwise problematic for OT.) This solution is shown in (8).

(8) Local conjunction solution to counterbleeding in OT

Input: /ʔiliː+l/	NO-HIGH $\&_l$ MAX-μ	NO-LONG-HIGH	NO-LONG-CLOSED	MAX-μ	IDENT(high)
a. [ʔiliːl]		* !	* !		
b. [ʔileːl]			* !		*
c. [ʔilil]	* !			*	
d. ☞ [ʔilel]				*	*

There are two main drawbacks to the local conjunction solution just sketched. The first is the invocation of a questionable constraint, NO-HIGH, as the markedness conjunct of the local conjunction. The second, more serious drawback is that this solution establishes no direct connection between the independent lowering and shortening processes: neither of them requires or makes use of the local conjunction. The SPE solution, by contrast, establishes the connection directly via ordering of the two rules. Now, neither of the processes on its own makes use of ordering either — precisely because each process is embodied in a single rule — but there's a clear sense in which the OT solution in (8) requires local conjunction in addition to constraints and ranking, whereas the SPE analysis in (4) only requires rules and ordering.

Another, more representationally-oriented solution, turbidity (Goldrick & Smolensky 1999, Goldrick 2001), would involve positing a distinction between 'projected' and 'pronounced' vowel length. In this solution, shortening is crucially the result of projecting but not pronouncing the second mora of a long vowel, in violation of a constraint requiring mora pronunciation, PRON-μ, rather than MAX-μ. In addition, the NO-HIGH-LONG constraint must penalize high vowels with two projected moras regardless of whether they are both pronounced (NO-PROJ-LONG-HIGH), and the NO-LONG-CLOSED constraint must penalize long vowels in closed syllables only if both moras are pronounced (NO-PRON-LONG-CLOSED). In this case, the connection between lowering and shortening is indirectly mediated via the hidden projected-but-not-pronounced moras, highlighted in (9) with outline font (ː).

(9) Turbidity solution to counterbleeding in OT

Input: /ʔiliː+l/	NO-PROJ-LONG-HIGH	NO-PRON-LONG-CLOSED	PRON-μ	IDENT(high)
a. [ʔiliːl]	* !	* !		
b. [ʔileːl]		* !		*
c. [ʔiliːl]	* !		*	
d. ☞ [ʔileːl]			*	*

The benefit of this solution over the local conjunction solution in (8) is that in (9), the closed syllable shortening process on its own also makes use of the hidden projected-but-not-pronounced moras necessary for the counterbleeding interaction with long vowel lowering. But of course, an analysis of closed syllable shortening on its own can be had without any of this hidden structure, as in the unadorned OT analysis of closed syllable shortening in (7); in other words, the only actual motivation for the projection/pronunciation distinction is to account for the counterbleeding interaction. Again, there's a clear sense in which the OT solution in (9) requires turbid representations in addition to constraints and ranking, whereas the SPE analysis in (4) only requires rules and ordering.

4 Self-destructive feeding

The unmarked status of feeding order is not subject to any serious doubt.
Kiparsky (1971:612)

Interestingly, there are some types of overapplication opacity that involve feeding rule orders. I call one such type of overapplication *self-destructive feeding*, an example of which is shown in (10).[9]

(10) Self-destructive feeding in Turkish (Sprouse 1997)

UR	/bebek+n/		
Ø → *i* / C __ C#	|bebekin|	= ℙ	*cf.* /ip+n/ → [ipin] 'your rope'
k → Ø / V __ +V	|bebein|	= ℚ	*cf.* /bebek+i/ → [bebei] 'baby (acc.)'
SR	[bebein]	'your baby'	

In Turkish, the vowel epenthesis rule ℙ sows the seeds of its own non-surface-apparentness by applying even between word-final consonant clusters where the first, stem-final consonant of the cluster is a *k* (or a velar stop more generally, depending on details of the analysis that are not germane here). The result of vowel epenthesis places the stem-final *k* in the crucial intervocalic position that causes it to undergo the velar stop deletion rule ℚ. This now-deleted *k* was of course a crucial part of the environment

[9] The morpheme boundary in the context of the velar stop deletion rule is necessary to account for the failure of morpheme-medial velar stop deletion in e.g. [hukuk] 'law school' (*cf.* [hukuu] 'law school (acc.)', with deletion of the stem-final velar stop).

for the prior vowel epenthesis rule ℙ, which has thus overapplied. This is thus technically speaking a case of *self-destructive feeding-on-environment* (the significance of which I return to in §7.3 below.)

A reviewer asks for evidence that the relevant vowel is epenthetic rather than underlying here; under this alternative analysis, note that a vowel deletion rule would be necessary to account for e.g. /baba+in/ → [baban] 'your father'.[10] Lees (1961:37-38) and Yavas (1980:74*ff*) both favor an epenthesis analysis in the case of final clusters in loanwords, and epenthetic vowels in Turkish generally are indeed high, but this does not in principle preclude a deletion analysis of the alternating possessive morpheme at hand. However, there is another rule in Turkish that self-destructively feeds velar stop deletion: a rule that deletes the continuants /s/ (of the third person singular possessive suffix) and /j/ (of the dative suffix) after consonants. The self-destructive feeding interaction between the two rules is shown in (11).

(11) More self-destructive feeding in Turkish (Kenstowicz & Kisseberth 1979)

UR	/ajak+sɯ/		
[+cont] → Ø / C__	|ajakɯ|	= ℙ	*cf.* /arɯ+sɯ/ → [arɯsɯ] 'his bee'
k → Ø / V __ +V	|ajaɯ|	= ℚ	*cf.* /ajak+ɯ/ → [ajaɯ] 'foot (acc.)'
SR	[ajaɯ] 'his foot'		

In this case, the continuant deletion rule ℙ sows the seeds of its own non-surface-apparentness by applying even after a stem-final *k*. The result of continuant deletion places the stem-final *k* in the crucial intervocalic position that causes it to undergo the velar stop deletion rule ℚ. This now-deleted *k* was of course a crucial part of the environment for the prior continuant deletion rule ℙ, which has thus overapplied. Now, unlike vowel epenthesis, the alternation between continuants and their absence cannot possibly submit to an alternative analysis because the choice between hypothetically epenthetic [s] and [j] would not be predictable (except perhaps as an arbitrary function of the suffix).

Because self-destructive feeding involves overapplication, and because feeding interactions are prototypically transparent, self-destructive feeding is easy to misidentify as counterbleeding; see, for example, Moreton & Smolensky (2002:315) and Potts & Pullum (2002:384-385), who both misidentify the case in (10) in exactly this way. But it can't be a case of counterbleeding, because the opposite order of the relevant rules does not result in a bleeding interaction. The velar stop is not yet intervocalic before application of velar stop deletion (= ℚ) under the ℚ-before-ℙ order, and so ℚ would simply not apply — leaving ℙ to apply alone, resulting in *[bebekin] in (10) or *[ajakɯ] in (11). The generalization expressed by ℚ in these hypothetical ℚ-before-ℙ orders would thus be non-surface-true; in other words, the relevant derivations would exhibit counterfeeding-on-environment opacity rather than bleeding.

[10] Note also that under this deletion analysis, the problem with the example in (10) would be that the vowel deletion rule underapplies (more specifically, that the derivation in (10) exhibits counterfeeding-on-environment opacity).

Again, the OT analysis of each of the independent processes is straightforward.[11] Suppose vowel epenthesis is due to a markedness constraint against tautosyllabic consonant clusters, No-Complex, ranked above a faithfulness constraint against vowel epenthesis, Dep-V. Since consonant deletion is in principle an alternative to vowel epenthesis that would also satisfy No-Complex, a faithfulness constraint against consonant deletion, Max-C, must also be ranked above Dep-V. This is shown in (12).

(12) Vowel epenthesis = ℙ

Input: /ip+n/	No-Complex	Max-C	Dep-V
a. [ipn]	* !		
b. ☞ [ipin]			*
c. [ip]		* !	

Velar stop deletion, on the other hand, is due to a markedness constraint against morpheme-final intervocalic velar stops, No-V*k*+V, ranked above Max-C. Since vowel epenthesis would in this case *not* be an alternative way to satisfy No-V*k*+V, the fact that Max-C is ranked above Dep-V is irrelevant.

(13) Velar stop deletion = ℚ

Input: /bebek+i/	No-V*k*+V	Max-C
a. [bebeki]	* !	
b. ☞ [bebei]		*

The (failed) attempt at an OT analysis of the self-destructive feeding interaction between these two processes, shown in (14), further clarifies how different it is from counterbleeding.

(14) Failure of self-destructive feeding in OT

Input: /bebek+n/	No-Complex	No-V*k*+V	Max-C	Dep-V
a. [bebekn]	* !			
b. [bebekin]		* !		*
c. ☞ [beben]			*	
d. ⊗ [bebein]			*	* !

The crucial difference is evident from the faithful candidate in (14)a, which violates only one of the two markedness constraints: No-Complex, but not No-V*k*+V. Compare this with the corresponding

[11] I restrict the OT discussion to the interaction between vowel epenthesis and velar stop deletion illustrated in (10) because the interaction between continuant deletion and velar stop deletion illustrated in (11) raises issues — such as whether Max-C needs to be split into different constraints to regulate each of the consonant deletion processes — that would take us too far afield.

faithful candidate in the failed attempt at a counterbleeding analysis in (7) above, which violates both of the two markedness constraints, NO-LONG-HIGH and NO-LONG-CLOSED.

The candidate with vowel epenthesis alone in (14)b is the one that introduces the crucial NO-V*k*+V violation, requiring velar stop deletion. But velar stop deletion alone, as in (14)c, would be sufficient to satisfy both markedness constraints; the additional violation of DEP-V in the actual output in (14)d is gratuitous, in the same way that the violation of IDENT(high) is gratuitous in the corresponding actual output candidate in the failed counterbleeding analysis in (7). It is that gratuitous faithfulness violation that led McCarthy (1999:358) to conclude that "[c]ounterbleeding interaction leads to non-surface-apparentness [= overapplication—EB], which is invariably problematic for OT's output orientation." The case of self-destructive feeding shows that gratuitous faithfulness violations result not only from counter-bleeding, and that it is exactly this aspect of both types of overapplication that presents a problem for OT.

Not suprisingly, potential solutions to the self-destructive feeding problem for OT are somewhat similar to those for counterbleeding. For example, one could concoct a complex constraint that penalizes the optimal candidate in (14)c and that dominates DEP-V, but in this case it would have to be a constraint that specifically penalizes deletion of a consonant in non-intervocalic contexts (MAX-C/¬V_V), something that is even more questionable than the local conjunction invoked for counterbleeding in (8) and which is required specifically for the analysis of opacity in addition to constraints and ranking.

(15) Complex constraint solution to self-destructive feeding in OT

Input: /bebek+n/	MAX-C/¬V_V	NO-COMPLEX	NO-V*k*+V	MAX-C	DEP-V
a. [bebekn]		* !			
b. [bebekin]			* !		*
c. [beben]	* !			*	
d. ☞ [bebein]				*	*

Another possible solution involves turbidity. Under this analysis, velar stop deletion would be the result of projecting but not pronouncing the velar stop (or its root node); this violates a constraint requiring consonant pronunciation, PRON-C, rather than MAX-C. In addition, the NO-COMPLEX constraint would need to penalize projected consonant clusters regardless of whether either of the consonants in the cluster is pronounced (NO-PROJ-COMPLEX), and the NO-V*k*+V constraint would need to penalize intervocalic velar stops only if they are pronounced (NO-PRON-V*k*+V). This solution is shown in (16).

(16) Turbidity solution to self-destructive feeding in OT

Input: /bebek+n/	NO-PROJ-COMPLEX	NO-PRON-V*k*+V	PRON-C	DEP-V
a. [bebekn]	* !			
b. [bebekin]		* !		*
c. [bebekn]	* !		*	
d. ☞ [bebekin]			*	*

This solution has exactly the same advantages as the turbidity solution to counterbleeding in (9), and is also subject to exactly the same criticisms leveled against that solution. The velar stop deletion process on its own also makes use of the hidden projected-but-not-pronounced consonants necessary for the self-destructive feeding interaction with vowel epenthesis, but an analysis of deletion is possible without this hidden structure, as in (13); the only motivation for the turbidity is to account for the self-destructive feeding interaction. Yet again, the OT solution in (16) requires turbid representations in addition to constraints and ranking, whereas the SPE analysis in (10) only requires rules and ordering.

Counterbleeding and self-destructive feeding are both examples of overapplication opacity and both involve what appears on the surface to be unmotivated process application or gratuitous faithfulness violation. However, it is not the case that all examples fitting the definition of overapplication opacity in (2)b involve gratuitous faithfulness violations, and such cases are amenable to analysis in OT.

5 Nongratuitous feeding

We turn now to another, perhaps more familiar type of pattern, but one which as far as I know has not been previously diagnosed as one that fits the definition of overapplication opacity in (2)b.[12] In Classical Arabic, a vowel copy epenthesis rule $\mathbb{P}$ crucially feeds a glottal stop epenthesis rule $\mathbb{Q}$. Because the appearance of $\mathbb{P}$'s motivating environment is crucially altered by $\mathbb{Q}$, the application of $\mathbb{P}$ is non-surface-apparent — but crucially not gratuitous, which is why I call this a case of *nongratuitous feeding*.

(17) Nongratuitous feeding in Classical Arabic (McCarthy, to appear)

UR	/ktub/		
Ø → V_i / # __ CCV_i	|uktub|	= $\mathbb{P}$	
Ø → ʔ / # __ V	|ʔuktub|	= $\mathbb{Q}$	*cf.* /al-walad-u/ → [ʔalwaladu] 'the boy (nom.)'
SR	[ʔuktub]	'write! (m.sg.)'	

One could object, at least in the case of this particular example, that the apparently opaque interaction involved is just an artifact of the representationally linear statements of these rules. It is well established

[12] I thank John McCarthy for particularly helpful discussion of the contents of this section.

in phonological theory that epenthesis processes like those illustrated in (17) are to be analyzed in terms of syllables and syllabification, and such nonlinear analyses may not involve any opaque interaction between the two processes. However, careful consideration of what a successful version of such an alternative nonlinear analysis must involve shows either that the opaque interaction is simply shifted onto other rules or that the right analysis of the facts should involve constraints and not rules in the first place.

One alternative is to assume that vowel copy epenthesis applies in order to syllabify otherwise unsyllabifiable consonants, and that syllabification applies persistently. The derivation of the relevant Classical Arabic form under this alternative is shown in (18), with syllabification indicated by parentheses.

(18) Nongratuitous feeding in Classical Arabic with persistent syllabification

UR	/ktub/	
Syllabification	|k(tub)|	
Vowel copy epenthesis	|uk(tub)|	
Syllabification	|(uk)(tub)|	
ʔ-epenthesis, SR	[(ʔuk)(tub)]	‘write! (m.sg.)’

The first pass of syllabification identifies the word-initial consonant as unsyllabifiable. Then, a copy vowel is epenthesized before this crucially unsyllabified consonant; this is followed by a reapplication of syllabification, which syllabifies the erstwhile word-initial consonant as a coda of the syllable headed by the epenthetic vowel. Notice that the environment motivating vowel copy epenthesis is already gone at this point in the derivation; in other words, vowel copy epenthesis still overapplies, but this time it is due to the persistent reapplication of syllabification and regardless of whether there is a glottal stop epenthesis rule. This is because the motivation for vowel copy epenthesis in (18) is to make the first consonant of a word-initial cluster syllabifiable; that consonant is subsequently syllabified, rendering the motivation for vowel copy epenthesis non-apparent on the surface. In fact, it can be said that all ‘repair rules’ are opaque in this same way: a repair takes a representation that meets some condition relevant to the surface-truth of some other generalization and returns a representation that no longer meets that condition, obscuring the motivation for the repair in the first place. In the case at hand, it is the surface-truth of persistent syllabification that is relevant — the underlying representation contains an unsyllabifiable consonant — and vowel copy epenthesis applies non-surface-apparently in order to make the consonant syllabifiable.

Another nonlinear alternative would be one in which epenthesis is a by-product of the imposition of a syllabic template (Ito 1989). This gets rid of the whole issue of ordering between the two epenthesis processes, because they can now be analyzed as simultaneous responses to syllabic template imposition: the word-initial consonant is associated with the coda of the syllabic template, the nucleus and onset of which are simultaneously filled by the relevant epenthetic segments. This is shown in (19).

(19) Nongratuitous feeding in Classical Arabic with syllabic template imposition

UR /ktub/

Syllabic Template Imposition

σ σ

C V C C V C

+ *simultaneous epentheses* → | ʔ *u* k t u b |

SR [(ʔuk)(tub)] 'write! (m.sg.)'

It is worth reflecting on the success of nonlinear analyses like the one in (19) and the import of this success for SPE and OT. The reason this type of analysis succeeds in getting rid of the whole issue of ordering between rules is because it relies instead on the idea that an output condition — a template — must be satisfied. This type of analysis is in all relevant respects the precursor of a typical OT analysis, where input-output disparities (= violations of faithfulness constraints, like those violated by epenthetic segments) are responses to well-formedness conditions (= markedness constraints, like those responsible for syllabification and syllabic structure). A syllabic template is, in essence, a constraint to be satisfied.

Indeed, the OT analysis of this sort of example is very straightforward. Vowel copy epenthesis is due to the ranking of NO-COMPLEX over DEP-V, and glottal stop epenthesis is due to the ranking of ONSET over DEP-C. So long as NO-COMPLEX also dominates DEP-C, then an input with an initial consonant cluster will undergo both epentheses, as shown by the tableau in (20) below.

(20) Nongratuitous feeding in OT

Input: /ktub/	NO-COMPLEX	ONSET	DEP-C	DEP-V
a. [(ktub)]	* !			
b. [(uk)(tub)]		* !		*
c. [(ʔktub)]	*(*) !		*	
d. ☞ [(ʔuk)(tub)]			*	*

The optimal candidate [(ʔuk)(tub)] in (20)d is favored over the fully faithful candidate *[(ktub)] in (20)a, because NO-COMPLEX dominates both DEP-C and DEP-V. The fully faithful candidate in (20)a is also favored over the candidate with only vowel copy epenthesis, *[(uk)(tub)] in (20)b, because ONSET dominates DEP-C. Note that the candidate with only glottal stop epenthesis, *[(ʔktub)] in (20)c, is harmonically bounded by the fully faithful candidate in (20)a, either because of the violation of DEP-C alone or because of both DEP-C and NO-COMPLEX, depending on whether NO-COMPLEX distinguishes initial CCCV from CCV (hence the parenthesized asterisk in the NO-COMPLEX column for (20)c).

Note in particular the parallels between the constraint-violation profiles in (20) and those for either of the solutions to self-destructive feeding in (15) and (16), particularly with the turbidity solution in (16). The reason nongratuitous feeding works in OT is because the markedness constraint responsible for process ℙ (here NO-COMPLEX, responsible for vowel copy epenthesis) penalizes not only the faithful candidate (20)a but also the candidate that undergoes only process ℚ (glottal stop epenthesis, (20)c). This is what both solutions to self-destructive feeding attempt to achieve; the turbidity solution in (16) does it by redefining the constraints and candidates themselves — in a relatively *ad hoc* but nevertheless effective manner — such that the candidates have roughly the same constraint-violation profiles that their corresponding candidates do in the case of nongratuitous feeding (20). (The complex constraint solution to self-destructive feeding in (15) achieves the same result, but with a separate, *ad hoc* complex constraint.)

Now consider the counterfeeding interaction that is predicted to be possible given the SPE rules in (17). If glottal stop epenthesis were to be ordered before vowel copy epenthesis, only underlyingly vowel-initial words would undergo glottal stop epenthesis and these words would thus be distinguished from underlyingly consonant cluster-initial words, which would undergo vowel copy epenthesis only. In other words, glottal stop epenthesis would underapply given this order of the rules; the generalization expressed by glottal stop epenthesis — that no words begin with vowels — would be non-surface-true.

The most straightforward OT analysis of this hypothetical case would be the kind discussed in relation to counterfeeding-on-environment in (3)b. The crucial violation of ONSET in those surface forms where glottal stop epenthesis underapplies would be due to the higher-rank of both NO-COMPLEX and the local conjunction of the two faithfulness constraints (DEP-C &$_l$ DEP-V), violated by the application of both epentheses to the same form (or, more specifically, adjacent to each other). Again, we are faced with a situation in which SPE predicts both rule orders to be on more or less equal grammatical footing, while OT predicts a nongratuitous feeding interaction to be the consequence of a particular ranking among simple constraints the re-ranking of which cannot by itself describe a counterfeeding interaction.

6 Cross-derivational feeding

6.1 Epenthesis and assimilation in Lithuanian

In Baković (2005) I argued for a rather unusual kind of process interaction in a set of prefix alternations in Lithuanian, resulting in a very different sort of overapplication opacity. The relevant facts are as presented in (21) and (22). (All Lithuanian examples cited here are drawn from Dambriunas *et al.* (1966), Kenstowicz & Kisseberth (1971), Kenstowicz (1972), Mathiassen (1996), and Ambrazas (1997); very special thanks are due to Solveiga Armoskaite for helpful elucidation and amplification of the data set.)

One process is assimilation: the consonant of each of the distinct verbal prefixes /at/ and /ap/ assimilates to an adjacent stem-initial consonant in terms of voicing and palatalization.[13]

(21) Lithuanian voicing and palatalization assimilation

at-ko:p^{j}t^{j}i	'to rise, climb up'	ap-kal^{j}b^{j}et^{j}i	'to slander'
ad-gaut^{j}i	'to get back'	ab-gaut^{j}i	'to deceive'
at^j-p^{j}aut^{j}i	'to cut off'	ap^j-t^{j}em^{j}d^{j}i:t^{j}i	'to obscure'
ad^j-b^{j}ek^{j}t^{j}i	'to run up'	ab^j-g^{j}i:d^{j}i:t^{j}i	'to cure (to some extent)'

The other process is epenthesis: if the initial consonant of a stem is identical to the prefix-final consonant or differs from it only in terms of voicing or palatalization (or both), /at/ and /ap/ surface as [at^{j}i] and [ap^{j}i], respectively (with automatic palatalization before the epenthetic [i]; see note 13).

(22) Lithuanian vowel epenthesis

at^{j}i-taik^{j}i:t^{j}i	'to make fit well'	ap^{j}i-put^{j}i	'to grow rotten'
at^{j}i-t^{j}eis^{j}t^{j}i	'to adjudicate'	ap^{j}i-p^{j}i:l^{j}t^{j}i	'to spill something on'
at^{j}i-duot^{j}i	'to give back, return'	ap^{j}i-bar^{j}t^{j}i	'to scold a little bit'
at^{j}i-d^{j}et^{j}i	'to delay, postpone'	ap^{j}i-b^{j}er^{j}t^{j}i	'to strew all over'

It is of course possible to describe the relevant Lithuanian facts with a conventional SPE derivation. We can take as our starting point the analysis discussed in textbook form by Odden (2005:113-115). Odden offers the two rules in (23). (Odden's transcriptions and discussion of assimilation do not include palatalization, and I follow suit in my discussion of Odden's analysis except where noted otherwise.)

(23) Rules for Lithuanian epenthesis and assimilation (Odden 2005)

a. Epenthesis

$$\text{Ø} \rightarrow i \;/\; \underset{[\alpha\text{place}]}{\text{obstruent stop}} \;\_\_\; \underset{[\alpha\text{place}]}{\text{obstruent stop}}$$

b. Assimilation

$$\text{obstruent} \rightarrow \text{voiced} \;/\; \_\_ \;\text{voiced obstruent}$$

Note that epenthesis is stated to apply between homorganic obstruent stops — effectively, *between consonants that differ at most in voicing* (and, in the full analysis, palatalization as well). By ordering epenthesis before assimilation, as Odden does, we have a bleeding-on-environment interaction between the two rules. A relevant example is derived in (24) below. Epenthesis applies first between the homorganic obstruent stops. Since these stops differ in voicing, this earlier application of epenthesis crucially bleeds the later assimilation rule by destroying the context necessary for the application of assimilation.

[13] More specifically, both assimilations apply regressively within consonant clusters; voicing assimilation is further limited to clusters of obstruents. Palatalization of consonants is automatic before front vowels and semi-contrastive otherwise; I henceforth simplify this distinction by specifying these particular consonants as palatalized in underlying representations.

(24) Epenthesis must precede and bleed assimilation

UR	/ap-berti/	
Epenthesis = (23)a	|api-berti|	
Assimilation = (23)b	– *bled* –	
SR	[api-berti]	(→ [ap^{j}i-b^{j}er^{j}t^{j}i], with palatalization)

Crucially missed in this descriptively satisfactory analysis, however, is a successful explanation of the fact that the assimilation rule is bled in precisely those contexts where it would otherwise create pairs of completely identical adjacent consonants. The paragraph just before Odden's statement of the epenthesis rule (unintentionally) reveals precisely this teleological weakness of the analysis (Odden 2005:115):

> "Lithuanian does not allow sequences of identical consonants, so to prevent such a result, an epenthetic vowel is inserted between homorganic obstruent stops […]."

An anonymous reviewer asks whether a feature-geometric representation would help to express the homorganicity requirement on the epenthesis rule in (23)a.[14] Identity could be required on adjacent Place (or C-Place) nodes, which reside on a tier distinct from laryngeal features like voicing and secondary articulations like palatalization. There are two significant problems with this idea. First, standard models of feature geometry house the features most likely to be involved in palatalization under the relevant node, leaving little justification for this reviewer's suggestion that it is "generally assumed [that] palatalization is represented under V-Place, in which case it will be independent of specifications for primary place of articulation (on C-Place)." In Clements & Hume's (1995:292) model, for example, V-Place is (indirectly) dominated by C-Place; an identity requirement on C-Place would thus entail identity on V-Place as well. Similarly, in the model proposed by Halle, Vaux & Wolfe (2000:389), Place dominates the Tongue Body and Tongue Blade nodes which between them include all of the features ([back], [anterior], [coronal], etc.) that are most likely to be involved in palatalization (see also Halle 1995:2). Again, requiring identity on Place entails requiring identity on these nodes and all of their dependent features.

Second, and more importantly, my point here and in Baković (2005) is not that a homorganicity requirement is representationally inexpressible, it's that such a requirement fails to relate this requirement to anything else about the grammar of Lithuanian. The question is *why* certain features are ignored in the determination of identity for the purposes of epenthesis; my proposed answer is that it is because of the interaction of epenthesis with assimilation. The feature-geometric answer suggested by the reviewer is that it is because C-Place is an independent node in the representation of a segment, and that epenthesis (or any process) can require identity for any node. (And if not *any* node, then the question becomes:

[14] For the sake of argument, I put aside the persuasive case made by Padgett (2002) for dispensing entirely with feature geometric representations within OT; see also Halle (2005:30) for a suggestion of the same conclusion within SPE.

which nodes?) But even if a C-Place node that includes all and only the right features can be motivated independently — and as noted in the paragraph immediately above, this is certainly not the generally accepted view — it remains a complete accident that, in Lithuanian, identity for the purposes of epenthesis is required for the node that just so happens to exclude just those features that independently assimilate.[15]

In sum, the epenthesis rule as stated in (23)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 (23)b. The epenthesis rule should instead be stated such that it applies between adjacent identical consonants only. The fact that an epenthetic vowel also surfaces between relevant near-identical consonants — that is, the fact that epenthesis overapplies in the (2)b sense — must somehow follow from some interaction between epenthesis and assimilation. In SPE, the only possible interaction is rule ordering, but as shown in (25) 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) and assimilation (still stated as in (23)b).

(25) Possible ordered interactions between epenthesis and assimilation

a. Epenthesis precedes assimilation

UR	/ap-berti/
Epen.	– *not applicable* –
Assim.	|ab-berti|
SR	*[ab-berti] (→ *[ab^{j}-b^{j}er^{j}t^{j}i])

b. Assimilation precedes epenthesis

UR	/ap-berti/
Assim.	|ab-berti|
Epen.	|abi-berti|
SR	*[abi-berti] (→ *[ab^{j}i-b^{j}er^{j}t^{j}i])

The reason this analysis fails is because the SPE derivation of a form proceeds one step at a time, with each rule taking as its input the representation that is the output of the immediately preceding rule in the order (or the underlying representation, in the case of the very first rule). Some work in the SPE framework, most notably by Kiparsky (1973 *et seq*.), attempted to restrict the possibilities of 'looking back' to some earlier point in the derivation (e.g., blocking in nonderived environments) and for 'looking forward' to some later point in the derivation (e.g., blocking of the immediate output of a rule). But the problem in the present case is neither one of looking back nor one of looking forward, but rather one of looking *over* to a counterfactual result along a separate, parallel derivational path. An attempt to represent

[15] It might be asked whether the right interaction between epenthesis and assimilation could be described using underspecification. Suppose the consonants of the prefixes /at/ and /ap/ are unspecified for voicing and palatalization and that the right values are provided either by assimilation or by default. These consonants are thus completely identical *in all specified respects* to consonants with the same values of all features except voicing and palatalization, and this modified sense of identity determines whether or not epenthesis applies. The problem with this approach is that voicing assimilation is feature-changing in Lithuanian:

i. /d^{j}irb + t^{j}i/ → [d^{j}ir^{j}p^{j}t^{j}i] 'work'
/b^{j}eg + t^{j}i/ → [b^{j}ek^{j}t^{j}i] 'run' ([+voi] → [–voi])

ii. /suk + damas/ → [sugdamas] 'twisting'
/kas + davo:/ → [kazdavo:] 'dug' ([–voi] → [+voi])

Underspecification of /at-/ and /ap-/ would thus be accidental, not predictable from the existence of assimilation; this is of course the same arbitrariness problem noted in the text. (The role of underspecification here, as in many cases when it is crucially invoked, is reduced to an (attempt to) account for an interaction that rule ordering is not powerful enough to handle on its own.)

what this analysis of Lithuanian would have to look like is given in annotated form in (26) below, clarifying the term that I choose to use for this type of pattern: *cross-derivational feeding*.

(26) Cross-derivational feeding in Lithuanian

$$\begin{tikzcd} & /\text{ap-b}^j\text{ert}^j\text{i}/ \arrow[dl, "\mathbb{Q}"'] \arrow[dr, "\mathbb{P}"] & \\ *|\text{ab}^j\text{-b}^j\text{er}^j\text{t}^j\text{i}| \arrow[rr, "\mathcal{F}"] & & [\text{ap}^j\text{i-b}^j\text{er}^j\text{t}^j\text{i}] \end{tikzcd}$$

$\mathbb{Q}$ = assimilation counterfactually applies, resulting in disallowed adjacent identical consonants
$\mathbb{P}$ = epenthesis overapplies between near-identical consonants, resulting in surface representation
$\mathcal{F}$ = cross-derivational feeding relationship

Rule $\mathbb{Q}$ applies in a counterfactual derivational step, the output of which is, as a result, subject to rule $\mathbb{P}$. Rather than $\mathbb{Q}$ directly feeding $\mathbb{P}$, however, $\mathbb{P}$ alone applies along a separate, actual derivational path. This economically renders both $\mathbb{P}$ and $\mathbb{Q}$ surface-true; however, $\mathbb{P}$ overapplies because the motivation for its application was the counterfactual application of $\mathbb{Q}$.[16] This type of example, which is technically a case of *cross-derivational feeding-on-environment* (see §7.3), is problematic for SPE because it involves the crucial feeding relation $\mathcal{F}$ across parallel derivations, one of them counterfactual. Like looking back and looking forward, the problem presented by cross-derivational feeding-on-environment is one of *globality*, and as discussed in §§6.2-6.3 below, this type of global interaction has a straightforward analysis in OT.

Interestingly, the standard bleeding-on-environment analysis of Lithuanian assimilation and epenthesis in (24) formed a crucial part of Kenstowicz & Kisseberth's (1971) challenge to Kiparsky's (1968) hypothesis that was noted at the end of §2. Kiparsky's hypothesis was that "[r]ules tend to shift into the order which allows their fullest utilization in the grammar", one consequence of this hypothesis being that bleeding orders are "marked" and are expected to become "unmarked" counterbleeding orders over time. What Kenstowicz & Kisseberth argue is that bleeding-on-environment order, as in the SPE analysis of Lithuanian in (23), is unmarked and diachronically stable, and that it is instead the opposite, counterbleeding-on-environment order that is marked (and probably unattested; see §6.4 below).

Kiparsky (1971) replied to this challenge with the opacity hypothesis, which reverses the markedness relation between bleeding and counterbleeding rule orders.[17] But as I have argued above, the real interaction between assimilation and epenthesis in Lithuanian actually involves overapplication opacity! To the extent that my argument is correct, and to the extent that the claim that the Lithuanian pattern is unmarked

[16] Another, perhaps more serially-friendly way to think of the interaction between $\mathbb{P}$ and $\mathbb{Q}$ is as follows. Suppose $\mathbb{Q}$ directly feeds $\mathbb{P}$, which in turn feeds a rule that specifically undoes any changes made by $\mathbb{Q}$ and nothing more (call it un-$\mathbb{Q}$). Under this analysis, $\mathbb{P}$ is rendered non-surface-apparent by un-$\mathbb{Q}$. At least two significant problems for such an analysis are immediately obvious: the lack of independent motivation for un-$\mathbb{Q}$, and how to prevent un-$\mathbb{Q}$ from applying when $\mathbb{P}$ does not apply.

[17] Kiparsky (1971:626) attributes his 1968 examples of bleeding orders that become counterbleeding orders over time to a "condition that allomorphy [within a paradigm] tends to be minimized" (Kiparsky 1971:596*ff*). This condition, of course, conflicts with the claim that transparent rule order is unmarked, and it is unclear how this conflict is to be generally resolved.

is also correct, the consequences for the theory of opacity are obvious: the hypothesis that all opaque generalizations as defined in (2) are hard to learn is at best too strong. (I return to this issue in §7.3 below.)

6.2 Analysis of cross-derivational feeding 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 (= nonoptimal). This fundamentally different property of OT allows for the kind of global interaction that is needed in order to properly account for examples of cross-derivational feeding. The different derivations involved in cross-derivational feeding are simply competing output candidates in the OT analysis, and correct adjudication of the conflict between them in the crucial set of near-identity cases falls out from the ranking that is independently required for the analysis of each of the two processes in other cases.

The core constraints necessary for the analysis of the Lithuanian pattern are as given in (27) below. I ignore here certain necessary but contextually irrelevant refinements of the analysis: the direction of assimilation, for example. I also ignore the automatic palatalization of the prefix consonant before the epenthetic high front vowel, and of assimilation elsewhere in the word, in the assessment of candidates.

(27) Constraints for analysis of the Lithuanian pattern (Baković 2005)
- a. i. AGREE(voi), violated by adjacent obstruents that differ in voicing.
  - ii. AGREE(pal), violated by adjacent consonants that differ in palatalization.
- b. i. IDENT(voi), violated by changes in voicing from input to output.
  - ii. IDENT(pal), violated by changes in palatalization from input to output.
- c. NO-GEM, violated by adjacent identical consonants (≈ geminates).
- d. DEP-V, violated by vowel epenthesis.

Assimilation between adjacent consonants differing in voicing or palatalization requires that each AGREE(*x*) constraint dominate its corresponding IDENT(*x*) constraint, as shown in collapsed form in (28). Note that since vowel epenthesis is in principle an alternative to assimilation that would also satisfy both AGREE(*x*) constraints, DEP-V must also be ranked above both IDENT(*x*) constraints.

(28) Assimilation between adjacent disagreeing consonants: [ad^j-b^{j}ek^{j}t^{j}i] 'to run up'

Input: /at-b^{j}ekt^{j}i/	AGREE(voi) AGREE(pal)	DEP-V	IDENT(voi) IDENT(pal)
a. [at-b^{j}ek^{j}t^{j}i]	* !		
b. ☞ [ad^j-b^{j}ek^{j}t^{j}i]			*
c. [at^{j}i-b^{j}ek^{j}t^{j}i]		* !	

In order to enforce epenthesis between adjacent identical consonants, NO-GEM must dominate DEP-V. The necessity of this ranking is illustrated in the tableau in (29) below, with the conflict between the fully faithful candidate [ap-put^{j}i] in (29)a losing to the candidate with epenthesis, [ap^{j}i-put^{j}i], in (29)b.

(29) Epenthesis between adjacent identical consonants: [ap^{j}i-put^{j}i] 'to grow rotten'

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

In this case, a change in voicing as in [ab-put^{j}i] in (29)c would in principle also be an alternative way to satisfy NO-GEM. Because it was shown in (28) above that DEP-V must be ranked above both IDENT(x) constraints, this candidate must be suboptimal due to the AGREE(x) constraints dominating DEP-V.

Given the ranking in (29), epenthesis in the case of adjacent near-identical consonants is automatically expected. This is shown in (30). The crucial suboptimal candidate in which assimilation applies but epenthesis does not is shown in (30)b; this candidate fatally violates NO-GEM, the markedness constraint otherwise responsible for epenthesis between completely identical consonants. Remaining faithful as in (30)a is of course not an option, because that violates one or both of the AGREE(x) constraints otherwise responsible for assimilation. The only remaining option is epenthesis, the optimal candidate in (30)c.

(30) Epenthesis, not assimilation: [ap^{j}i-b^{j}er^{j}t^{j}i] 'to strew all over'

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

This is a completely straightforward OT analysis that properly describes the right generalization about the distribution of the epenthetic vowel in Lithuanian. Other examples of cross-derivational feeding-on-environment that I am currently aware of also involve interactions between consonantal assimilation processes and epenthesis to avoid adjacent identical consonants, as in Lithuanian; perhaps the most familiar example is the case of inflectional suffix allomorphy in English (see Baković 2005). As I show in §7 further below, there also exist cases of cross-derivational feeding-on-focus.

6.3 The crucial role of globality

Cross-derivational feeding requires an unprecedented type of global mechanism, one in which the consequences of a crucially counterfactual derivational path — that is, a mapping from an underlying representation to a distinct representation that does not actually surface in the language — must be considered in order to properly define the conditions necessary for a separate derivational path from the underlying representation to the actual surface representation. These separate derivational paths, one actual and one counterfactual, are equally necessary in order for the correct generalization to be expressed.

In the OT analysis detailed in §6.2, the end points of these two derivational paths simply constitute two of the competing candidate outputs derived from the underlying representation, one optimal and the other suboptimal. The choice between these two candidates is correctly and automatically made by the rankings independently responsible for each of the interacting processes (assimilation and epenthesis).

The success of this OT analysis is not at all surprising, given that global interactions of several kinds succumb naturally to unified explanation in OT in ways that have not been possible in other frameworks of process interaction.[18] In this section I discuss how cross-derivational feeding fits into a larger typology of global interactions involving *blocking* (‘do something except when’), a relatively simple case of which was already noted in §1. A more complex class of blocking patterns, *conspiracies* (following Kisseberth 1970), is discussed by Pater (1999) and McCarthy (2002:95*ff*). Cross-derivational feeding is essentially a special case of a conspiracy in the typology of blocking patterns, as described in (31) below.[19]

(31) Typology of blocking patterns

<u>Blocking</u>: A general process ℚ is prevented from applying in a defined class of cases.

- <u>Simple blocking</u>: No other process necessarily applies because ℚ is blocked, resulting in surface examples of the input to ℚ.
- <u>Conspiracy</u>: Another process ℙ necessarily applies because ℚ is blocked, removing surface examples of the input to ℚ.
  - <u>Cross-derivational feeding</u>: The context of application for ℙ is crucially motivated by the counterfactual (blocked) output of ℚ.

Consider this typology in terms of counterfactual derivations, as described and schematically represented in (32) below. Note that the schematic representations allow the closer relationship between conspiracies and cross-derivational feeding to stand out particularly clearly.

[18] I use ‘process interaction’ here as a cover term for ‘rule interaction’, ‘constraint interaction’, and ‘rule-constraint interaction’; though of course both the terms ‘process’ and ‘interaction’ are themselves understood differently in different frameworks.

[19] Hill’s (1970) case of a ‘peeking’ rule in Cupeño is another example that can be described in terms of blocking: an iteration of a rule is blocked when its output exceeds a particular target. However, Hill’s own analysis suggests an alternative interpretation: iterations of a rule are *triggered* until the desired target — in the case of Cupeño, a templatic requrement — is met.

(32) Typology of blocking patterns in terms of counterfactual derivations

- Simple blocking /X/ → *|Y| is blocked, and so /X/ surfaces unchanged. The conditions motivating the blocked counterfactual path /X/ → *|Y| are present on the surface, because no other relevant process applies.

$$\begin{tikzcd} & /\mathrm{X}/ \arrow[dl] \arrow[dr] & \\ {*|\mathrm{Y}|} & & {[\mathrm{X}]} \end{tikzcd}$$

- Conspiracy: /X/ → *|Y| is blocked, and so /X/ surfaces as [Z] instead. The conditions motivating the blocked counterfactual path /X/ → *|Y| are not present on the surface, because another process /X/ → [Z] gets rid of them.

$$\begin{tikzcd} & /\mathrm{X}/ \arrow[dl] \arrow[dr] & \\ {*|\mathrm{Y}|} & & {[\mathrm{Z}]} \end{tikzcd}$$

  - Cross-derivational feeding: The conditions for the application of /X/ → [Z] are found in the blocked counterfactual path /X/ → *|Y|.

$$\begin{tikzcd} & /\mathrm{X}/ \arrow[dl] \arrow[dr] & \\ {*|\mathrm{Y}|} \arrow[rr, "\mathcal{F}"] & & {[\mathrm{Z}]} \end{tikzcd}$$

The blocked counterfactual path in each case is the failed mapping /X/ → *|Y|, and the actual path is /X/ → [X] in the case of simple blocking and /X/ → [Z] in the case of conspiracies, including cross-derivational feeding. The difference between cross-derivational feeding and other types of conspiracies concerns the relationship between the counterfactual and actual outputs: there is a feeding relationship between *|Y| and [Z] in the case cross-derivational feeding, as indicated by the horizontal $\mathcal{F}$-arrow, and no such relationship in the case of other types of conspiracies.

In OT, these different blocking patterns result from particular rankings of constraints that lead to the choice of X over Y in the case of simple blocking, and to the choice of Z over (both X and) Y in the case of a conspiracy, including cross-derivational feeding. This is shown in the ranking schemas in (33), where $\mathbb{M}$ is a markedness constraint, $\mathbb{F}$ is a faithfulness constraint, and $\mathbb{C}$ is either of these. Subscripts denote what is penalized by each constraint; 'Y/…' indicates the contextual restriction on the markedness or faithfulness of (a change to) Y that must exist in order for the blocking of /X/ → *|Y| to be evident.

(33) Basic constraint ranking schemas for blocking patterns

a. Simple blocking	b. Conspiracy	c. Cross-derivational feeding
$\mathbb{M}_{Y/\dots} \gg \mathbb{M}_X$	$\mathbb{M}_X, \mathbb{C}_{Y/\dots} \gg \mathbb{F}_Z \gg \mathbb{F}_Y$	$\mathbb{M}_X, \mathbb{M}_{Y/\dots} \gg \mathbb{F}_Z \gg \mathbb{F}_Y$

An example of the simple blocking schema in (33)a was already illustrated by the blocking of extrametricality in Latin monosyllables in (1). In that particular case, the markedness constraint $\mathbb{M}_X$ otherwise responsible for the blocked process of extrametricality is NONFINALITY, and the markedness constraint $\mathbb{M}_{Y/\dots}$ doing the blocking is LX≈PR, requiring that words be prosodified and stressed.

The cross-derivational feeding schema in (33)c is of course just a special case of the conspiracy schema in (33)b; the unspecified $\mathbb{C}_{Y/\dots}$ is simply further specified as being a markedness constraint ($\mathbb{M}_{Y/\dots}$)

in the case of cross-derivational feeding. The relevant tableau from the Lithuanian analysis is (30), where there are two markedness constraints $\mathbb{M}_X$ otherwise responsible for the blocked assimilation processes (AGREE(voi), AGREE(pal)). The markedness constraint $\mathbb{M}_{Y/...}$ causing assimilation to be blocked is NO-GEM, the faithfulness constraint $\mathbb{F}_Z$ penalizing the optimal candidate with epenthesis is DEP-V, and the faithfulness constraints $\mathbb{F}_Y$ penalizing the blocked assimilation candidate are the IDENT(*x*) constraints.

In other examples of conspiracies, the unspecified constraint $\mathbb{C}_{Y/...}$ is a faithfulness constraint ($\mathbb{F}_{Y/...}$), as exemplified by Pater's (1999) analysis of the pattern of nasal + voiceless obstruent avoidance in Si-Luyana. Nasal + voiceless stop sequences are avoided via coalescence of the nasal and stop, satisfying a markedness constraint against nasal + voiceless obstruent sequences (*N$\mathring{C}$) and violating the faithfulness constraint LINEARITY; this justifies the ranking ⟦*N$\mathring{C}$ ≫ LINEARITY⟧ (= ⟦$\mathbb{M}_X \gg \mathbb{F}_Y$⟧). Deletion could have also been employed to satisfy *N$\mathring{C}$, justifying the ranking ⟦MAX ≫ LINEARITY⟧ (= ⟦$\mathbb{F}_Z \gg \mathbb{F}_Y$⟧).

(34) Conspiracy I: coalescence of nasal + voiceless stop sequences in Si-Luyana

Input: /N_1 + $t_2$abi/ 'prince'	*N$\mathring{C}$	MAX	LINEARITY
a. [$n_1t_2$abi]	* !		
b. ☞ [$n_{1,2}$abi]			*
c. [$t_2$abi]		* !	

*N$\mathring{C}$ also penalizes nasal + voiceless fricative sequences, but coalescence in these cases would further violate the faithfulness constraint IDENT(cont). Here deletion occurs instead, violating MAX and justifying the ranking ⟦*N$\mathring{C}$, IDENT(cont) ≫ MAX⟧ (= ⟦$\mathbb{M}_X$, $\mathbb{F}_{Y/...} \gg \mathbb{F}_Z$⟧). This is shown in (35).

(35) Conspiracy II: deletion in nasal + voiceless fricative sequences in Si-Luyana

Input: /N_1 + $s_2$upa/ 'soup'	*N$\mathring{C}$	IDENT(cont)	MAX	LINEARITY
a. [$n_1s_2$upa]	* !			
b. [$n_{1,2}$upa]		* !		*
c. ☞ [$s_2$upa]			*	

An important distinction between the analysis of cross-derivational feeding in (30) and that of other types of conspiracies in (35) is whether optimal derivations of the form /Y/ → [Z] are otherwise predicted to exist. In the case of cross-derivational feeding, such derivations are necessarily optimal. In Lithuanian, for example, NO-GEM enforces epenthesis even when assimilation is not relevant (e.g., in /ap-put^{j}i/ → [ap^{j}i-put^{j}i] 'to grow rotten') because it dominates DEP-V. In the case of other conspiracies, by contrast, /Y/ → [Z] derivations are not necessarily expected to be optimal. In Si-Luyana, for example, deletion of the nasal is not necessarily expected unless coalescence of the nasal with a voiceless fricative is at stake, since it is only the possibility of coalescence that invokes the blocking constraint IDENT(cont). This is not to say that deletion of a nasal cannot be otherwise motivated, of course; what is relevant here are the *necessary* expectations from the ranking schemas in (33): cross-derivational feeding *requires* other independently-motivated /Y/ → [Z] mappings; other types of conspiracies do not.

Examples discussed in the literature under the banner of 'conspiracies' tend to be of the type that fit McCarthy's (2002) slogan "homogeneity of target, heterogeneity of process" — examples in which the avoidance of a single marked configuration (or set of related configurations) is responsible for more than one underlying-surface disparity. This is also true, to an extent, of cross-derivational feeding: in Lithuanian, the avoidance of disagreeing clusters is responsible for assimilation and, in certain cases, for epenthesis as well. In the case of epenthesis, however, this responsibility is crucially shared with the avoidance of another marked configuration: adjacent identical consonants, which are specifically in danger of resulting from assimilation. The conspiracy in this case thus involves the simultaneous avoidance of both marked configurations with one of two underlying-surface disparities: assimilation when only disagreement is at stake, and epenthesis when adjacent identical consonants are (also) at stake.

In his discussion of conspiracies and their relation to opacity, Kiparsky (1973:80-81) concluded:

> "Two rules A and B may be defined as belonging to a 'conspiracy' if both are [surface-true], and a change in (or loss of) A would render B [non-surface-true]. […] The explanation of conspiracies is thereby reduced to the theory of opacity. The fact that [l]anguages tend to have conspiracies follows from the more general fact that [l]anguages tend to have transparent rules."

The results of this section suggest a more nuanced conclusion: conspiracies lead to increased surface-truth, and this can happen at the expense of surface-apparentness — though perhaps only of the kind that does not involve unnecessary rule application or gratuitous faithfulness violation. This appears to be true for cross-derivational feeding and also for nongratuitous feeding, as discussed with respect to (18) in §5.

In sum, OT's facility with cross-derivational feeding follows from the global properties of the theory, and SPE's difficulty with this type of pattern follows from its lack of such properties. This fact has potential consequences for refinements of OT such as those by Wilson (2000) and by McCarthy (to appear), both of which significantly affect OT's predictions of globality. Aspects of either or both proposals may turn out to be necessary in some form, and they have the added benefit of being able to describe some of the types of opacity discussed in this article that are otherwise problematic for OT. In assessing these proposals, however, the positive aspects of globality noted in this section must be kept firmly in mind.

6.4 More on gratuitous faithfulness violations

Consider again the analysis of cross-derivational feeding in Lithuanian in (30), repeated as (36) but with another candidate added in (36)d, one in which there is both assimilation and epenthesis.

(36) Cross-derivational feeding: Lithuanian prefixes, based on (30)

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

It would of course be problematic for OT if (36)d were the actual output in Lithuanian, because this candidate is harmonically bounded by the optimal candidate in (36)c: the additional faithfulness violation incurred by (36)d in the IDENT(x) column is gratuitous. Indeed, because the standard SPE analysis of Lithuanian involves bleeding — recall Odden's (2005) rules in (23) and the derivation in (24) — a simple reordering of the rules under such an analysis results in (36)d and would be a case of counterbleeding.

(37) Lithuanian bleeding (Odden 2005, based on (24)) and anti-Lithuanian counterbleeding

a. Epenthesis bleeds assimilation

UR	/ap-berti/	
Epen.	|api-berti|	
Assim.	– *bled* –	
SR	[api-berti]	(→ [ap^{j}i-b^{j}er^{j}t^{j}i])

b. Epenthesis counterbleeds assimilation

UR	/ap-berti/	
Assim.	|ab-berti|	
Epen.	|abi-berti|	
SR	*[abi-berti]	(→ *[ab^{j}i-b^{j}er^{j}t^{j}i])

But note that the codicil on epenthesis that is necessary under the bleeding order of rules in (37)a, specifying that the flanking consonants may 'differ at most in voicing (and palatalization)', would no longer be motivated under the opposite ordering of the rules in (37)b. This is because the prior application of assimilation would in all relevant cases guarantee that the flanking consonants agree in voicing (and palatalization). So, the result in (37)b is due to a self-destructive feeding interaction: assimilation provides the necessary environment for the subsequent application of epenthesis, which destroys the context that made the application of assimilation possible in the first place. (This is reflected in the constraint violation profiles of the candidates in (36); compare counterbleeding in (7) and self-destructive feeding in (14).)

This kind of interaction between assimilation and epenthesis appears to be completely unattested, as originally suggested by Kenstowicz & Kisseberth (1971). The one apparent counterexample to this claim that is known to me comes from New Julfa Armenian (Vaux 1998, Odden 2005). Since epenthesis in this case applies regardless of featural (dis)agreement, this is a standard counterbleeding interaction.

(38) Epenthesis and assimilation in New Julfa Armenian (Vaux 1998, Odden 2005)

a. Epenthesis of schwa between future prefix /k-/ and consonants, not vowels

k-ert^{h}am	'I will go'	k-asiem	'I will say'
kə-tam	'I will give'	kə-kienam	'I will exist'

b. Laryngeal (voicing and spread glottis) assimilation across epenthetic schwa

gə-bəzzam	'I will buzz'	gə-zəṙam	'I will bray'
k^{h}ə-t^{h}uoʁniem	'I will allow'	k^{h}ə-t͡ʃ^{h}ap^{h}iem	'I will measure'
g^{h}ə-b^{h}ieriem	'I will carry'	g^{h}ə-g^{h}uom	'I will come'

Vaux writes (1998:216, emphasis added): "Since intervening *-ə-* but not full vowels are transparent to [assimilation], *we can say* that this rule applies before epenthesis, *which produces all schwas* in the New Julfa dialect." While this is technically true, the facts simply do not justify such an analysis. Even if all predictable information must be absent from underlying representations — see Orgun (2000:141) on this point, specifically with regard to the analysis of schwa epenthesis in Armenian — the predictability of the distribution of schwa only *allows* assimilation to be ordered before epenthesis. Vaux presents no specific argument for this ordering analysis, empirical or otherwise; a more plausible alternative is implicit in Vaux's own proposed statement of the rule specifying that schwa is transparent to assimilation.

Support for the schwa-transparency analysis comes from the urban Utrecht dialect of Dutch, which has regressive voicing assimilation across non-epenthetic schwa (van Oostendorp 2002, p.c.). As shown in (39) below, the masculine definite determiner /də/ is devoiced before stem-initial voiceless obstruents and the infinitival marker /tə/ is voiced before stem-initial voiced obstruents (39)a; the underlying distinction between these two inflectional morphemes surfaces before stem-initial sonorants (39)b.

(39) Assimilation across schwa in urban Utrecht Dutch (van Oostendorp 2002, p.c.)

a. Voicing assimilation before obstruents

[də] bakker	'the baker'	[də] bakken	'to bake'
[tə] pastoor	'the priest'	[tə] pakken	'to take'

b. Faithful voicing before sonorants

[də] maker	'the maker'	[tə] maken	'to make'

Assimilation of laryngeal features across reduced vowels should not be surprising, given the likely articulatory configuration involved: the gestures of consonants flanking a reduced vowel no doubt overlap more than they do when flanking a full vowel, if they overlap in the latter case at all. If the sense of consonantal adjacency relevant to assimilation is (or at least can be) defined in terms of (degree of) gestural overlap, then the New Julfa Armenian and urban Utrecht Dutch patterns above are expected.[20]

[20] Basbøll (1972:40-41) claims in passing that there is "an American English dialect where the plural of words ending in an unvoiced sibilant is [ɪs] instead of [ɪz] [which] may be accounted for in a simple way by saying that the dialect in question has reordered the two rules [assimilation and epenthesis]". I know of no work verifying the existence of such a dialect of English.

The ordering solution suggested by Vaux (1998) entails the possibility of a counterbleeding interaction between epenthesis and assimilation: a pattern in which epenthetic vowels are distributionally distinguishable from otherwise identical underlying vowels (e.g., with evidence from morphophonological alternations), and in which assimilation applies only across the epenthetic vowels. This hypothetical pattern, unattested to the best of my knowledge, would be impossible to replicate in OT except by brute force.[21] 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.

7 Concealed free rides

7.1 Gliding and deletion in Cibaeño Dominican Spanish

The final type of process interaction involving obscured generalizations that I examine in this article are what I call *concealed free rides*. Concealed free rides are of interest here for a couple of reasons. First, there are two reasonable ways to analyze a concealed free ride: (i) in terms of self-destructive feeding, which is possible in SPE but not in OT, or (ii) in terms of cross-derivational feeding, which is possible in OT but not in SPE. Second, the types of obscured generalizations that arise from concealed free rides turn out not to be classifiable as opaque according to the standard definition of opacity in (2).

Consider the following example from the Cibaeño variety of Spanish, spoken in the north-central region of El Cibao in the Dominican Republic (Golibart 1976, Guitart 1981).[22] In Cibaeño, there is a process of liquid gliding whereby the liquids /r/ and /l/ become the palatal glide [y] word-internally before consonants (40)a and word-finally in a stressed syllable (40)b. (Guitart (1981) argues that the context of liquid gliding is not, despite appearances, reducible to syllable-final position. I simply adopt Guitart's position in what follows, as the issue does not affect the point being made here.)

(40) Liquid gliding in Cibaeño

a.	__ C:	/karta/ → [káyta] 'letter'	/alta/ → [áyta] 'tall (f.)'
	cf. __ V:	/kara/ → [kára] 'face'	/ala/ → [ála] 'wing'
b.	V́ __ #:	/kantor/ → [kantóy] 'singer'	/papel/ → [papéy] 'paper'
	cf. V́ __ +V:	/kantor+es/ → [kantóres] 'singers'	/papel+es/ → [papéles] 'papers'

[21] Two possibilities come to mind. (I) Posit versions of AGREE(*x*) constraints for which segmental adjacency is defined by the input representation, where consonants separated by an epenthetic vowel on the surface are adjacent. This possibility predicts that a vowel deletion rule could also counterfeed assimilation. (II) Posit versions of AGREE(*x*) constraints for which segmental adjacency specifically ignores epenthetic segments or that specifically penalize epenthetic vowels flanked by disagreeing consonants.

[22] I thank Bruce Hayes for bringing this case to my attention and for discussing it with me. A comparable (but substantially more involved) example of a concealed free ride exists in Chicano Spanish (see Baković, in press, and references cited therein).

Word-final liquids in unstressed monosyllabic words also glide, but only before consonant-initial words; compare *el mes* [eymés] 'the month' with *el año* [eláño] 'the year'. Guitart (1981:227) reduces this to the word-internal pre-consonantal vs. pre-vocalic cases in (40)a. Guitart argues that the relevant unstressed monosyllables are all determiners and prepositions with a plausible analysis as proclitics, and so the final liquids of these morphemes is word-internal in the relevant cases (/el+mes/ → [eymés], /el+año/ → [eláño]) and thus conforms to the word-internal pre-consonantal vs. pre-vocalic distinction.

Some underlying liquids in the relevant positions delete instead of surfacing as glides. Golibart (1976) and Guitart (1981) demonstrate that deletion in these cases is motivated by either one or both of two independent conditions, one phonotactic and the other prosodic. Consider first the phonotactically-motivated case. Pre-consonantal or word-final liquids after /i/ delete instead of surfacing as glides, as would otherwise be expected given the liquid gliding rule. But surface sequences of a high vowel and homorganic glide (*iy, yi, uw, wu*) are independently excluded in Spanish, a phonotactic fact that can be reasonably attributed to an independent glide deletion rule. Golibart (1976) and Guitart (1981) thus analyze liquid deletion as a two-step process: liquid gliding feeds the glide deletion rule. This is shown in (41).

(41) Liquid gliding feeds phonotactically-motivated glide deletion

UR	/sirße/	/silßo/	/salir/	/fusil/
$r,l \rightarrow y$ / __ $\begin{Bmatrix} C \\ \# \end{Bmatrix}$	|siyße|	|siyßo|	|saliy|	|fusiy|
$G_i \rightarrow \varnothing$ / V_i __	|siße|	|sißo|	|sali|	|fusi|
SR	[síße] 'it serves'	[síßo] 'I whistle'	[salí] 'to go out'	[fusí] 'gun'
	cf. /salßo/ → [sáyßo] 'I save'		*cf.* /salar/ → [salár] 'to salt'	

The independent motivation for this glide deletion rule is, as noted above, the systematic absence in Spanish of high vowel and homorganic glide sequences like *iy*. There is no further evidence for the rule in Cibaeño, but Guitart (1981:224), following Golibart (1976:51-54), suggests that second person plural familiar verb forms, found exclusively in Peninsular varieties of Spanish, provide some external motivation for the rule. The suffix (or suffixal complex) that instantiates this morphosyntactic feature set is [y]-initial after first (42)a and second (42)b conjugation verbs, which are marked by the theme vowels *a* and *e*, respectively. Third conjugation verbs (42)c are marked by the theme vowel *i*, and the underlying sequence /…i+y…/ arguably undergoes the phonotactically-motivated glide deletion rule in (41) to surface as [i].

(42) Second person plural verb forms (*tv* = verb conjugation theme vowel)

a.	*amáis*	/am+a+ys/ *love+tv+2pl.fam. (first conjugation)*	→	[amáys]	'you (pl. fam.) love'
b.	*coméis*	/kom+e+ys/ *eat+tv+2pl.fam. (second conjugation)*	→	[koméys]	'you (pl. fam.) eat'
c.	*salís*	/sal+i+ys/ *go-out+tv+2pl.fam. (third conjugation)*	→	[salís], *[salíys]	'you (pl. fam.) go out'

Now consider prosodically-motivated deletion. When a word with nonfinal stress ends underlyingly with a liquid — the residue of the prosodic contexts classified by the liquid gliding context in (40)b — there is again deletion rather than a surface glide. Stems ending in closed unstressed syllables are generally considered exceptional in analyses of Spanish stress (see e.g. Harris 1995), but glide-final stems are unexceptionally stressed on the final syllable. As Guitart (1981:225) puts it, "[i]n Spanish in general there are absolutely no polysyllabic words ending in unstressed vowel plus glide."[23] Guitart attributes the absence of these words to a prosodically-motivated deletion rule, summarizing its statement as follows: "[d]elete [y] at the end of a polysyllabic word whenever it is preceded by an unstressed vowel." Guitart's formal statement of the rule is in essential respects equivalent to the rule stated in (43). Like the phontactically-motivated rule, this prosodically-motivated glide deletion rule is crucially fed by liquid gliding.

(43) Liquid gliding feeds prosodically-motivated glide deletion

UR	/kánser/	/reßólßer/
$r,l \rightarrow y$ / __ $\{^{\mathrm{C}}_{\#}\}$	|kánsey|	|reßóyßey|
$y \rightarrow \emptyset$ / $\sigma C_0\breve{V}$ __ #	|kánse|	|reßóyße|
SR	[kánse] 'cancer'	[reßóyße] 'revolver'
	cf. /kansar/ → [kansáy] 'to tire'	*cf.* /reßolßer/ → [reßoyßéy] 'to stir'

Note that the only independent motivation for this prosodically-motivated glide deletion rule is the systematic absence of glide-final polysyllabic words with nonfinal stress in Spanish; there is no further evidence for it, even of the external type given for phontactically-motivated glide deletion in (42).

The Cibaeño pattern just described is an example of a concealed free ride. More generally, free rides are so named because they can be analyzed in SPE terms in the following way (see Zwicky 1970). Suppose an analysis of some phonological pattern involves input-output mappings of the form /X/ → [Z], and that these mappings can be broken down into two serially-ordered derivational steps, /X/ → |Y| → [Z]. If the |Y| → [Z] step is independently motivated in some way — most convincingly, but not necessarily, by other observed mappings of the form /Y/ → [Z] — then the process responsible for the /X/ → |Y| step can 'take a free ride' on the independently-motivated process responsible for the |Y| → [Z] step.[24]

[23] The 'polysyllabic' detail was necessary for Guitart to temporarily put aside the behavior of monosyllabic determiners and prepositions, as noted just after (40) in the text above. Guitart's indubitably correct analysis of those monosyllabic words as proclitics renders this detail unnecessary, but I follow Guitart in continuing to mention it here.

[24] Zwicky's (1970) main concern was with "an oft-used methodological rule of thumb" that he dubs the *Free-Ride Principle*, which favors a free-ride analysis /X/ → |Y| → [Z] over an otherwise descriptively-equivalent alternative with a more direct rule /X/ → [Z]. Although Zwicky's conclusion is that the Free-Ride Principle "lacks empirical confirmation and hence should not be applied incautiously" (1970:587), he implies that some motivation for the Free-Ride Principle might be found in the fact that "the domain of applicability" of the independently motivated rule /Y/ → [Z] "will be increased" in a free-ride analysis (1970:579). This also appears to be the motivation behind Kiparsky's (1968) "fullest utilization" hypothesis (see §2, §6.1 above).

In the Cibaeño example, liquid gliding takes a free ride on glide deletion, resulting in derivations of the form /r,l/ → |y| → Ø. (I refer to the two glide deletion rules together simply as 'glide deletion' in much of what follows.) The reason I call it a *concealed* free ride is because glide deletion completely conceals the result of liquid gliding. This concealment makes the SPE analysis of a concealed free ride, as illustrated by the derivations in (41) and (43), remarkably similar to the analysis of self-destructive feeding in Turkish discussed in §4: the |y| → Ø step taken by glide deletion destroys the result of the serially prior /r,l/ → |y| step taken by liquid gliding, but of course the result of liquid gliding was necessary to motivate the destructive application of glide deletion in the first place. One might think, then, that the analysis of a concealed free ride is problematic for OT for the same reasons that self-destructive feeding is.

But the interaction between the rules involved in a concealed free ride can also be understood in cross-derivational feeding terms, much like the interaction between assimilation and epenthesis in Lithuanian discussed in §6. The essence of a cross-derivational feeding analysis of the Cibaeño example can be summarized as follows. Pre-consonantal and word-final liquids become palatal glides unless either (i) the result would be a phonotactically impermissible sequence (**iy*) or (ii) the result would be a prosodically impermissible form ($*\sigma C\breve{V}y\#$). In these two classes of cases, pre-consonantal and word-final liquids delete instead; this is because if they were to counterfactually become glides, they would be subject to glide deletion anyway. A schematic representation of this cross-derivational feeding interaction is shown in (44).

(44) Cross-derivational feeding in Cibaeño

$$\begin{tikzcd}
& \begin{array}{c}/\text{salír}/\\ /\text{kánser}/\end{array} \arrow[dl, "\mathrm{LG}_{\mathrm{CF}}"'] \arrow[dr, "\mathrm{GD}_{\mathrm{A}}"] & \\
\begin{array}{c}*|\text{salíy}|\\ *|\text{kánsey}|\end{array} \arrow[rr, "\mathcal{F}"] & & \begin{array}{c}[\text{salí}]\\ [\text{kánse}]\end{array}
\end{tikzcd}$$

$\mathrm{LG}_{\mathrm{CF}}$ = counterfactual application of liquid gliding
GD_{A} = actual application of glide deletion
$\mathcal{F}$ = cross-derivational feeding relationship

Deletion is a thus a back-up strategy to gliding under this analysis: liquids delete whenever gliding would otherwise be blocked. This makes the OT analysis of a concealed free ride straightforward.

7.2 Analysis of concealed free rides in OT

Both gliding and deletion are possible responses to a markedness constraint against pre-consonantal or word-final liquids, here simply abbreviated No-$r,l\left\{\begin{smallmatrix}\mathrm{C}\\ \#\end{smallmatrix}\right\}$. Those responses are regulated by particular faithfulness constraints ranked below No-$r,l\left\{\begin{smallmatrix}\mathrm{C}\\ \#\end{smallmatrix}\right\}$; in order to ensure that gliding as opposed to deletion is the default response, Max-C must be ranked above any and all Ident(x) constraints where x is a feature that distinguishes the liquids /r,l/ from the glide /y/. To keep things simple, I assume that liquids and glides are primarily distinguished by the feature [±consonantal] and I refer to the relevant set of Ident(x) constraints as IDENT(cons). The preference for gliding over deletion is realized in examples where the phonotactic and prosodic conditions are not at stake, as shown in (45).

(45) Gliding by default

Input: /papel/ ‘paper’	NO-*r,l*$\{{}^{\mathrm{C}}_{\#}\}$	MAX-C	IDENT(cons)
a. [papél]	* !		
b. ☞ [papéy]			*
c. [papé]		* !	

The phonotactic constraint responsible for the lack of sequences of high vowels and homorganic glides is abbreviated here NO-V̯G. When NO-V̯G is at stake, the preference for gliding is subverted and there is deletion instead, so long as NO-V̯G is ranked together with NO-*r,l*$\{{}^{\mathrm{C}}_{\#}\}$ above MAX-C.

(46) Deletion under phonotactic duress

Input: /salir/ ‘to go out’	NO-*r,l*$\{{}^{\mathrm{C}}_{\#}\}$	NO-V̯G	MAX-C	IDENT(cons)
a. [salír]	* !			
b. [salíy]		* !		*
c. ☞ [salí]			*	

Likewise, when the prosodic constraint responsible for the lack of polysyllabic glide-final words with nonfinal stress is at stake, the preference for gliding is again subverted and there is deletion instead. This prosodic constraint is abbreviated here as NO-σCV̆*y*# (probably a constraint on quantity sensitivity, activated by independent considerations that ensure the heaviness of word-final syllables ending in glides).

(47) Deletion under prosodic duress

Input: /kánser/ ‘cancer’	NO-*r,l*$\{{}^{\mathrm{C}}_{\#}\}$	NO-σCV̆*y*#	MAX-C	IDENT(cons)
a. [kánser]	* !			
b. [kánsey]		* !		*
c. ☞ [kánse]			*	

The rankings in (46) and (47) are clear instances of the basic constraint ranking schema for cross-derivational feeding (33)c, repeated below as (48). The markedness constraint $\mathbb{M}_{X}$ is NO-*r,l*$\{{}^{\mathrm{C}}_{\#}\}$, otherwise responsible for liquid gliding; the markedness constraint $\mathbb{M}_{Y/\ldots}$ causing gliding to be blocked is NO-V̯G in (46) and NO-σCV̆*y*# in (47), the faithfulness constraint $\mathbb{F}_{Z}$ penalizing the optimal candidate with deletion is MAX-C, and the faithfulness constraint $\mathbb{F}_{Y}$ penalizing the blocked gliding candidate is IDENT(cons).

(48) Cross-derivational feeding ranking schema, repeated from (33)c
$\mathbb{M}_{X}, \mathbb{M}_{Y/\ldots} \gg \mathbb{F}_{Z} \gg \mathbb{F}_{Y}$

This cross-derivational feeding analysis of the fate of Cibaeño liquids in glide-deletion contexts makes sense of the fact that deletion is a response to independent constraints in the language that conflict with the preferred liquid gliding strategy. Of course, the prediction of this analysis is that deletion should be independently observable given an appropriate context; i.e., a glide arising after a homorganic high vowel (recall (42)), or one arising finally in a form with nonfinal stress. This is not necessarily so of the self-destructive feeding analysis in (41) and (43), where the liquid gliding rule could in principle be preceded by rules that make changes other than deletion that also lead to conformity with the relevant phonotactic and prosodic conditions; e.g., a rule shifting stress to the final syllable in glide-final words.

It is perhaps relevant that glide-final loanwords with nonfinal stress in the source language are produced with final stress in Spanish; e.g. [kombóy] < English *cónvoy*. This could be taken as evidence for the stress shift rule just mentioned in the actual phonological grammar of Spanish, preceding liquid gliding in Cibaeño and coincidentally having the same motivation as the glide deletion rule in (43). Whether this is the right approach to loanword phonology is a question far beyond the scope of this article; the more relevant problem for this analysis lies behind the motivation for stress shift and glide deletion: the lack of an effective description of — much less an explanation for — the teleological unity of these rules.

7.3 Concealed free rides and opacity

Given the similarities between concealed free rides and self-destructive feeding on the one hand and cross-derivational feeding on the other, a concealed free ride might be expected to involve overapplication opacity. It is the first process in a self-destructive feeding interaction that overapplies, and this corresponds to liquid gliding in the SPE analysis of the concealed free ride in Cibaeño. By contrast, it is the actually applying process that overapplies in the case of cross-derivational feeding, and this corresponds to glide deletion in Cibaeño. Does this mean that both processes express opaque generalizations due to their interaction with each other? The matter turns out to be more complicated than one might think.

On the one hand, it is clearly the case that each of the two processes expresses a generalization that is *obscured* by its interaction with the other. Liquid gliding turns liquids into glides, but this transformation is obscured by the fact that some of those glides-from-liquids are subsequently deleted. Similarly, glide deletion deletes glides, but this is obscured by the fact that some glides come from underlying liquids, which glide deletion also deletes. There is a clear intuitive sense in which glide deletion can be thought to overapply, then: glide deletion appears to delete more than just glides. Conversely, liquid gliding is obscured but it is pretty clear that it doesn't overapply: it doesn't appear to apply to more than just liquids, nor does it result in glides in contexts other than those stated by the rule.

In fact, neither process can be classified as *opaque* in either of the two senses of the term according to Kiparsky's definition of opacity in (2). For ease of reference, this definition is repeated here.

(2) A process ℙ of the form $A \rightarrow B / C\_\_D$ is *opaque*
to the extent that there are surface representations of the form:
a. A in the environment $C\_\_D$, or [= *non-surface-true / underapplication opacity*]
b. B derived by ℙ in environments other than $C\_\_D$. [= *non-surface-apparent / overapplication opacity*]

First of all, liquid gliding does not overapply in the (2)b sense: there are no surface instances of glides derived by liquid gliding that occur in environments other than pre-consonantally or word-finally. Liquid gliding also does not underapply in the (2)a sense: there are also no surface instances of liquids that occur pre-consonantally or word-finally. Likewise, glide deletion clearly does not underapply according to the definition in (2)a because there are no surface instances of glides in either of the two deletion environments (and recall that the surface truth of this fact is the primary motivation for both types of glide deletion in the first place). It proves to be somewhat trickier to square the definition of overapplication in (2)b with a deletion rule: what constitutes a surface instance of B when B is Ø, the absence of a segment? Even assuming that there is a way to refer to 'deleted segments', however, glide deletion does not overapply according to the definition in (2)b because there are no instances of deleted segments derived by glide deletion in environments other than those in the two deletion environments.[25]

The interaction between the processes involved in a concealed free ride is thus, somewhat counterintuitively, a transparent one according to the standard definition of opacity. The source of this puzzle appears to be the formal distinction that we have encountered several times throughout this article: the concealed free ride in Cibaeño involves *feeding-on-focus*, while the self-destructive feeding and cross-derivational feeding examples discussed in §4 and §6 both involve *feeding-on-environment*. The diagnostic for overapplication in (2)b is defined in such a way that only a disruption of the environment of a process ℙ can mean that ℙ has overapplied, which thus excludes on-focus interactions.

It might be asked what consequences this result has for the theory of opacity, and the answer is unclear. The definition of opacity in (2) simply identifies surface diagnostics for opaque generalizations, and so the definition itself could in principle just be modified to accomodate concealed free rides if there were

[25] As noted in footnote 4, Kiparsky (1973:79) added a third diagnostic that was meant to cover cases of neutralization: B not derived by ℙ in the environment $C\_\_D$. Liquid gliding does in fact neutralize the underlying distinction between liquids and glides, but because there are no glides on the surface in the relevant concealed free-ride derivations, this case of neutralization does not match the diagnostic. Glide deletion also neutralizes the underlying distinction between glides and Ø, but this neutralization is not particular to concealed free-ride derivations; in fact, it would appear that *all* deletion rules are neutralizing in this larger sense.

reason to believe that concealed free rides must involve opacity. But recall that the theory of opacity is based on the substantive assumption that opaque generalizations are harder to learn than transparent ones; given that it is unknown whether the obscured generalizations involved in concealed free rides are easier or harder to learn than other generalizations, it is unclear whether they should be considered opaque.

Now recall that Kiparsky's original evidence for the psychological reality of the opacity of a particular (type of) rule order was more or less the extent to which such an order could be shown to be diachronically unstable. If, for example, an innovating dialect appears to require the inverse of an inherited order between two rules, this could be an indication that the inherited order is opaque while its innovated inverse is transparent. However, note that the inverse of a concealed free ride would be a case of *counterfeeding*, and thus a genuine case of (underapplication) opacity. In a putative innovative subdialect of Cibaeño, glide deletion would not delete those instances of glides derived by the now later-ordered liquid gliding rule, rendering glide deletion non-surface-true. If a concealed free ride indeed involves opacity, then, it cannot be diagnosed by some diachronic tendency for the rules involved to be reordered.

8 Summary and concluding remarks

I hope to have shown in this article that overapplication opacity is more diverse than formerly thought, and that three previously overlooked types of overapplication opacity have implications for the description of opaque generalizations both with ranked constraints in OT and with ordered rules in SPE.

Overapplication opacity is generally thought to be due only to counterbleeding interactions in an SPE analysis (§3), but two of the overlooked types of overapplication opacity are due to straightforward feeding interactions; this fact by itself is somewhat surprising since feeding interactions are generally thought to be transparent. Self-destructive feeding-on-environment (§4) is similar to counterbleeding in that application of just the second of the two rules would be sufficient to satisfy the apparent requirements of both; that is, to ensure that the generalizations expressed by both rules are surface-true. Application of both rules is thus excessive, involving a gratuitous violation of faithfulness that makes an OT analysis difficult. Nongratuitous feeding (§5) is different: application of both rules is necessary to make them both surface-true, even though application of the first rule is rendered non-surface-apparent by application of the second. This difference is what makes nongratuitous feeding amenable to simple analysis in OT.

Although the example of cross-derivational feeding-on-environment in Lithuanian (§6) fits the definition of overapplication opacity, an analysis in terms of rule ordering in SPE is simply not possible unless the crucial relationship argued here to exist between the rules involved is blatantly disregarded. Thus, while SPE has for some time been argued to be uniquely capable of describing all types of opaque generalizations, cross-derivational feeding-on-environment is a clear case of an opaque generalization that is not describable in terms of rule ordering. In order to describe such an opaque generalization properly, SPE would need to be supplemented with what amounts to candidate output comparison in OT: parallel derivations, including counterfactual ones that crucially influence the actual one. This is thus a case of overapplication opacity that can *only* be described in terms of OT.

Concealed free rides (§7) constitute a particularly interesting class of process interactions in the present context. For one thing, analyses of concealed free rides are possible both in SPE and in OT; it is a self-destructive feeding-on-focus interaction in the former and a cross-derivational feeding-on-focus interaction in the latter. The feeding-on-focus part appears to be what makes an analysis in both frameworks possible; compare self-destructive feeding-on-environment (§4), which is only analyzable in SPE, and cross-derivational feeding-on-environment (§6), which is only analyzable in OT. Another remarkable aspect of concealed free rides is that they involve no overapplication or underapplication according to the standard definition of opacity in (2). This result is somewhat counterintuitive, but it is unclear whether it warrants any modification to the definition of opacity. We simply don't know whether concealed free rides, or indeed many of the cases discussed in this article, are hard to learn. There is no other context for the definition of opacity other than the hypothesis that opaque generalizations are hard to learn; more case-by-case empirical work is needed to confirm or disconfirm this substantive hypothesis.

Two major implications of this paper can be summarized as follows. The definition of opacity identifies opaque generalizations, not only those that SPE predicts. Examples of generalizations that are opaque by this definition should thus challenge our *a priori* notions of what the better framework of analysis is. Likewise, the purpose of the theory of opacity is to account for the ways in which opaque generalizations are hard to learn, and so apparent examples of opaque generalizations should challenge our *a priori* notions of what it means for a generalization to be opaque or hard to learn in the first place.

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