Shifting interactions and countershifting opacity: A note on opacity in Harmonic Serialism*

Ezer Rasin, Tel Aviv University, Draft of April 2021

To appear in *Linguistic Inquiry*

1 Overview

McCarthy (2008) and Elfner (2016) have shown that Harmonic Serialism (HS; McCarthy 2000, 2016), a serial variant of Optimality Theory (OT; Prince and Smolensky 1993/2004), can generate certain opaque interactions between stress and vowel deletion or epenthesis that seem to pose a challenge to Parallel OT.[1] At the same time, McCarthy (2000, 2007) has argued that HS is unable to generate canonical cases of counterfeeding and counterbleeding opacity.[2] Given our current understanding of opacity, this is a mystery: the opaque interactions discussed by McCarthy and Elfner are not of any familiar type (counterfeeding, counterbleeding, or any other type in Baković 2007, 2011), and it remains unclear whether they are isolated cases or rather instantiations of a yet unknown class of opaque interactions.

This note will argue that there is indeed a generalization regarding a class of opaque interactions that HS can generate, and at least the stress-epenthesis interactions discussed by Elfner, as well as additional opaque interactions discussed in this paper, are special cases of this general class. The new generalization, given in (1), will rely on

*For helpful feedback and discussion, I am grateful to Daniel Asherov, Roni Katzir, Gereon Müller, Jochen Trommer, Eva Zimmermann, the audience at the Leipzig Opacity Symposium (hosted by Leipzig University on May 29–30, 2020), an anonymous *LI* reviewer, and especially Eric Baković, whose suggestions have significantly improved the quality of this note.

[1]This note assumes familiarity with the terms *opacity*, *feeding*, *bleeding*, *counterfeeding*, and *counterbleeding*, which originated in Kiparsky 1968, 1971 and Newton 1971. See Baković 2011 for an overview.

[2]The restriction to "canonical" cases is important. McCarthy (2000), Torres-Tamarit (2012, 2016), and Müller (2020) have shown that certain cases of counterbleeding opacity with special properties can be generated by HS. I discuss this further in §3.4.

new terminology regarding pairwise process interactions that includes the new terms *shifting* and *countershifting*.

(1) *The countershifting generalization*

HS can successfully apply the opaque process in countershifting interactions (but generally not in counterbleeding or counterfeeding).

A process $\mathbb{A}$ is said to *shift* a process $\mathbb{B}$ if $\mathbb{A}$ does not feed or bleed $\mathbb{B}$ but still affects $\mathbb{B}$'s application by making it apply in a different way. *Countershifting* is the opaque counterfactual inverse of *shifting*. The term *countershifting* will be shown to fill a basic gap in the traditional taxonomy of opaque process interactions into counterfeeding and counterbleeding, a gap already identified by Kiparsky (2015).

The new generalization in (1) will be developed in a few steps. First, in §2, I will introduce the new terms *shifting* and *countershifting*. In §3 I will compare the ability of HS to generate a simple case of countershifting with its inability to generate a canonical case of counterbleeding. I will explain why the difference between shifting and bleeding is responsible for this expressive difference. Finally, in §4, I will illustrate the generality of countershifting opacity using several attested examples of countershifting from morphophonology. In addition, I will present a proof-of-concept HS analysis of a case of countershifting opacity involving reduplication.

2 Terminology: shifting and countershifting

As noted by Kiparsky (2015:15), the traditional taxonomy of pairwise process interactions into (counter-)feeding and (counter-)bleeding is incomplete, as it ignores attested interactions where a process $\mathbb{A}$ neither feeds nor bleeds another process $\mathbb{B}$ but still affects $\mathbb{B}$'s application. The derivation table in (2) illustrates.

(2)

Shifting	/CVCVCV/
APOCOPE	CVCVC
STRESS	CV́CVC
	[CV́CVC]

(3)

Countershifting	/CVCVCV/
STRESS	CVCV́CV
APOCOPE	CVCV́C
	[CVCV́C]

In (2), a process of APOCOPE deletes a word-final vowel and is followed by a process STRESS that assigns stress to the penultimate syllable. This interaction of APOCOPE and STRESS is not a feeding interaction, because APOCOPE does not create any additional inputs to STRESS. Neither is it a bleeding interaction, because APOCOPE eliminates no potential inputs to STRESS. Instead, STRESS applies regardless of the application of APOCOPE, but APOCOPE still affects it by making it apply to a different syllable. Interactions of this nature that cannot be described using the notions "feeding" or "bleeding" have been discussed in Zwicky 1987 and Baković and Blumenfeld 2019, where they are referred to as "transfusions" (a term Zwicky 1987 attributes to an unpublished paper by Donald Churma).[3] Here I will refer to interactions as in (2) using the term *shifting*, because APOCOPE can be thought of as shifting the locus of application of STRESS.

In (3), we have the reverse ordering of the two processes. Here, APOCOPE applies after STRESS and makes STRESS opaque: even though STRESS targets the penultimate syllable, stress falls on the final syllable on the surface. Following the same reasoning regarding feeding and bleeding as before, this opacity is not a case of counterfeeding or counterbleeding (neither is it an opacity of any other type identified in Baković 2007, 2011), and I will refer to it as *countershifting*.[4,5]

[3]"*If one rule transfuses another, the string to which the second rule applies is different from what it would be if the first rule didn't apply–either because the first rule removes some material to which the second could apply but also supplies new places for the second to apply in, or because the first rule changes one string to which the second is applicable into a different string to which the second rule is applicable.*" (Zwicky 1987, p. 93) I am grateful to Eric Baković for bringing this to my attention.

[4]Kiparsky (2015:15) writes on such interactions involving stress: "*Here the terms '(non-)feeding' and '(non-)bleeding', or for that matter 'overapplication' and 'underapplication', are not appropriate [...] it is just that stress is assigned to a different syllable.*"

[5]It is not immediately obvious that the difference between shifting on the one hand and feeding and bleeding on the other hand is meaningful enough to justify the introduction of a new term. At first sight, it might seem tempting to try to revise the definitions of feeding and bleeding to characterize the interaction in (2) by localizing these terms to a certain position in the string. On this view, APOCOPE might be said to feed STRESS relative to the first syllable of the word and bleed it relative to the second syllable. A definitional localization of this kind is already needed in some form or another, given that a process $\mathbb{A}$ can feed another process $\mathbb{B}$ in one position in the string while bleeding it in another. Consider, for example, a process of vowel deletion that removes a vowel before a following adjacent vowel, and a process of palatalization that turns /k/ into /k^j/ before /i/, as well as their interaction in (i). Here, the net effect of the application of vowel deletion is that palatalization applies in a different position in the string. Conversely, in (ii), vowel deletion counterfeeds palatalization in the first half of the string and

It would be useful to give more precise working definitions of *shifting* and *countershifting* to make it easier to identify and label new interactions of this type.[6] In the following definitions I use φ to denote a phonological representation, which will typically be the input to the derivation, and $X(\varphi)$ to denote the result of applying the process X to the representation φ. A proposed working definition of shifting is given in (4).

(4) A process $\mathbb{A}$ *shifts* another process $\mathbb{B}$ in the derivation of $\mathbb{B}(\mathbb{A}(\varphi))$ if the following properties hold of the relationship between $\mathbb{A}$, $\mathbb{B}$, and φ:

a. $\mathbb{A}(\varphi) \neq \varphi$ ($\mathbb{A}$ applies non-vacuously to φ)

b. $\mathbb{B}(\varphi) \neq \varphi$ ($\mathbb{B}$ applies non-vacuously to φ)

c. $\mathbb{B}(\mathbb{A}(\varphi)) \neq \mathbb{A}(\varphi)$ (after applying $\mathbb{A}$ to φ, $\mathbb{B}$ applies non-vacuously)

d. $\mathbb{B}(\mathbb{A}(\varphi)) \neq \mathbb{A}(\mathbb{B}(\varphi))$ (the order of application matters)

According to this definition, an interaction between a process $\mathbb{A}$ and a later process $\mathbb{B}$ is considered a shifting interaction if it meets the following conditions. First, the earlier process $\mathbb{A}$ applies non-vacuously to the input (4a). Second, the later process $\mathbb{B}$ would have applied non-vacuously to the input had it applied first (4b). This condition excludes the possibility that the interaction is a feeding interaction, because otherwise the context for $\mathbb{B}$ would have been created by $\mathbb{A}$ rather than being present in the input.

counterbleeds it in the second half.

(i)

Feeding+bleeding	/kui kiu/
Vowel deletion	ki ku
Palatalization	k^ji ku
	[k^ji ku]

(ii)

Counter-(feeding+bleeding)	/kui kiu/
Palatalization	kui k^jiu
Vowel deletion	ki k^ju
	[ki k^ju]

Despite the apparent similarity between shifting and a combination of localized feeding and bleeding as in (i), it turns out that the two kinds of interactions are meaningfully different. Intuitively, the difference is that there are two non-overlapping contexts of application for palatalization in (i) but only one context of application for STRESS in (2). This difference translates into divergent theoretical consequences for HS. In particular, as we will see in the next section, while HS can generate the inverse of shifting in (2) – namely, countershifting, as in (3) – it cannot generate the inverse of localized feeding and bleeding in (i) – namely, the interaction in (ii). This divergence in theoretical consequences is what will justify treating shifting as a distinct, atomic interaction.

[6] I am grateful to Eric Baković for suggesting the definitions below over a more complicated version in a previous draft.

The next condition is that $\mathbb{B}$ still applies non-vacuously after the application of $\mathbb{A}$ (4c). Given this condition, this is not a bleeding interaction, because otherwise $\mathbb{A}$ would have removed the context for $\mathbb{B}$, preventing $\mathbb{B}$ from applying. Finally, the order of application of $\mathbb{A}$ and $\mathbb{B}$ matters, so the two interact. Taken together, we can interpret these conditions as follows: $\mathbb{B}$ can apply either before or after $\mathbb{A}$, and nevertheless the early (non-vacuous) application of $\mathbb{A}$ results in a non-vacuous interaction. The interaction in (2) meets these conditions, assuming that $\mathbb{A}$ is APOCOPE and $\mathbb{B}$ is STRESS: APOCOPE applies non-vacuously to the input, STRESS can apply non-vacuously to the input or after APOCOPE, and applying both in the opposite order would have yielded the different output [CVCV́C].

We can define *countershifting* as the opaque counterfactual inverse of shifting, as in (5). The interaction in (3) meets this definition, assuming that $\mathbb{A}$ is STRESS and $\mathbb{B}$ is APOCOPE, since we have just seen that APOCOPE would have shifted STRESS had it applied first. This working definition of countershifting will be used in the discussion of HS, to which I turn next.[7]

(5) A process $\mathbb{B}$ *countershifts* another process $\mathbb{A}$ in the derivation of $\mathbb{B}(\mathbb{A}(\varphi))$ if $\mathbb{B}$ *shifts* $\mathbb{A}$ in the derivation of $\mathbb{A}(\mathbb{B}(\varphi))$.

3 The countershifting generalization for HS

3.1 Background: HS and the order of operations

HS (McCarthy 2000, 2016) is a serial version of OT. Like Parallel OT, an HS grammar includes one set of ranked, violable constraints. Differently from Parallel OT, computation is serial. GEN, which generates output candidates, is limited to changing the input by at most one atomic change at a time (epenthesis, deletion, feature change, etc.). At

[7]Notice that the proposed working definition of *shifting* is not fine-grained enough to exclude the interaction in (i) in ft. 4 – an edge case that combines feeding and bleeding – and thus the definition of *countershifting* does not exclude (ii) in ft. 4. As mentioned in that footnote, a meaningful difference between shifting and (i) seems to be that (i) involves multiple non-overlapping contexts of application for a single process. A more precise definition of *shifting* would presumably be sensitive to this difference and exclude (i), but this is not a direction I will develop in this squib.

each step of the derivation, EVAL selects the most harmonic candidate as the output, which then serves as the input for the next step. GEN and EVAL loop until convergence.

In HS, the constraint ranking determines the order of operations. As an example, consider a hypothetical language with the following two processes: palatalization of /k/ before /i/ and high vowel deletion in a non-final open syllable. Assume an HS-based grammar where the markedness constraint that triggers palatalization is **ki* and the constraint that triggers high vowel deletion in non-final open syllables is **i*CV (the constraints in this section are taken from McCarthy's 2007 discussion of Bedouin Hijazi Arabic, which will be reviewed below). Consider the hypothetical UR /kirmila/, to which the two processes apply without interacting, yielding the output [k^{j}irm.la]. If **ki* outranks **i*CV, palatalization would apply first. In the first step of the HS derivation, given in (6), there would be at least three output candidates: the faithful candidate (a), the candidate in which palatalization applies (b), and the candidate in which deletion applies (c) (since GEN cannot make more than one change in every step, there is no candidate in which both processes apply; syllabification is assumed not to count as an additional process). Since candidate (b) is the only candidate that does not violate the highest-ranking **ki*, palatalization is the only process that applies in Step I.

(6) Palatalization precedes deletion, Step I

		/kirmila/	**ki*	**i*CV	MAX	IDENT[back]
a.		kir.mi.la	*!	*		
b.	☞	k^{j}ir.mi.la		*		*
c.		kirm.la	*!		*	

The output of Step I, [k^{j}ir.mi.la], serves as the input to Step II (by assumption, the constraint ranking does not change between steps). Now that **ki* has been resolved, constraint evaluation can attend to the next constraint in the ranking, **i*CV, which triggers the deletion of the second /i/, yielding the output [k^{j}irm.la]:

(7) Palatalization precedes deletion, Step II

	/k^jir.mi.la /	$^*ki$	$^*i$CV	MAX	IDENT[back]
a.	k^jir.mi.la		*!		
b. ☞	k^jirm.la			*	

As all markedness constraints have been resolved, the faithful candidate will win in Step III (not shown here), and [k^jirm.la] is the final output. It is easy to verify that an alternative constraint ranking, where $^*i$CV outranks $^*ki$, would have produced the same output, but with the reverse order of application of the two non-interacting processes.

Despite the serial nature of HS, McCarthy (2000, 2007) has shown that HS cannot generate canonical cases of counterbleeding and counterfeeding opacity. Understanding the failure of HS on counterbleeding will make it easier to see why it succeeds on countershifting. Therefore, in the next section, I review McCarthy's (2007) demonstration of why HS fails on counterbleeding in Bedouin Hijazi Arabic and characterize the reason for the failure.

3.2 Why HS fails on counterbleeding

In Bedouin Hijazi Arabic (Al-Mozainy 1981; McCarthy 2007), palatalization ($k \to k^j$ before i) is counterbled by syncope ($i \to \emptyset$ in non-final open syllables), two processes we have seen in the previous section. The result is mappings like /ħaːkim-in/ → [ħaːk^jm-in], where palatalization is opaque, as it applies even though its context for application is no longer present on the surface. As noted by McCarthy, the challenge for HS is to apply palatalization before syncope. The tableau for Step I of the derivation of /ħaːkim-in/ is given in (8). Here, $^*ki$ outranks $^*i$CV, a ranking needed to try to make palatalization apply before syncope. The ranking of $^*i$CV over MAX is needed to trigger syncope, and the ranking of $^*ki$ over IDENT[back] is needed to trigger palatalization. In this tableau, candidate (a) is obtained by applying palatalization to the UR, and candidate (b) is obtained by applying syncope before palatalization. The problem for HS, since syncope destroys the context for palatalization, is that applying syncope to the UR in the first step of the derivation satisfies the markedness constraint triggering syncope (=*iCV) *and* the markedness constraint triggering palatalization (=*ki). The result is that candidate (b), in which syncope has applied first, is incorrectly chosen as the winner. The colored cell in the tableau highlights the absence of a violation that causes the failure.

(8) Attempt at counterbleeding, Step I

		/ħaːkim-in/	*ki	*iCV	MAX	IDENT[back]
a.	☹	ħaː.kʲi.min		*!		*
b.	☞	ħaːk.min			*	

The reasoning that leads to a problem for HS is general and goes beyond this particular case of counterbleeding. In canonical counterbleeding interactions, a process $\mathbb{A}$ applies before a process $\mathbb{B}$ which destroys $\mathbb{A}$'s context for application. Since $\mathbb{B}$ removes the context for $\mathbb{A}$, applying $\mathbb{B}$ first would satisfy the markedness constraints that trigger both processes. This results in the application of $\mathbb{B}$ to the UR, which, by destroying the context for $\mathbb{A}$, incorrectly blocks $\mathbb{A}$'s application. The failure, then, is directly related to the following property of counterbleeding:

(9) $\mathbb{A}(\mathbb{B}(\varphi)) = \mathbb{B}(\varphi)$ ($\mathbb{B}$ removes the context for $\mathbb{A}$)

This property is not shared by countershifting, where $\mathbb{A}(\mathbb{B}(\varphi)) \neq \mathbb{B}(\varphi)$, due to condition (4c) in the inverse definition of shifting. In the next section we will see that if the opaque interaction is one of countershifting rather than counterbleeding, the problem indeed disappears.

3.3 Why HS succeeds on countershifting

Consider again the schematic countershifting interaction between STRESS and APOCOPE from §2, and the mapping /CVCVCV/ → [CVCV́C] which results in final stress on the surface. To best highlight the difference between countershifting and counterbleeding, I will first assume that stress assignment is triggered by a cover markedness constraint STRESS!, which penalizes a surface representation unless its final two syllables comprise a trochaic foot (the constraint STRESS! will be decomposed into more familiar constraints below, after the comparison with counterbleeding). Apocope is triggered by the constraint *V#. Similarly to the counterbleeding case, the tableau in (10) has two candidates: candidate (a) in which the first process (here, STRESS) has applied, and candidate (b) in which the second process (here, APOCOPE) has applied. Differently from the counterbleeding case, here candidate (b) receives a fatal violation (highlighted) from the highest-ranking markedness constraint, and candidate (a) – the correct candidate in Step I – wins.

(10) Countershifting, Step I (schematic, to be updated below)

		/CVCVCV/	STRESS!	*V#	MAX	IDENT[stress]
a.	☞	CV(CV́CV)		*		*
b.		CVCVC	*!		*	

Why does countershifting behave differently from counterbleeding? Given the shifting component of countershifting, APOCOPE would not *destroy* the context for STRESS if applied first but rather *shift* it (see, in particular, condition (4c) in the definition of shifting). And shifting means that STRESS could still apply to [CVCVC] even if APOCOPE had applied first. In terms of constraint satisfaction, the ability of STRESS to apply to [CVCVC] translates into the highlighted violation of the constraint STRESS!. As a result of this violation, Step I of the derivation succeeds and STRESS correctly applies before APOCOPE.

As was the case with counterbleeding, this reasoning is general and goes beyond this particular case of countershifting. In countershifting interactions, a process $\mathbb{A}$ applies before a process $\mathbb{B}$ which can shift $\mathbb{A}$'s context for application. Since $\mathbb{B}$ only shifts the context for $\mathbb{A}$ but does not remove it, $\mathbb{A}$ could apply even after the application of $\mathbb{B}$, so applying $\mathbb{B}$ first would not satisfy the markedness constraint that triggers $\mathbb{A}$. This results in the correct application of $\mathbb{A}$ to the UR, thus avoiding the problem for counterbleeding in Step I of the derivation. The generality of this reasoning will be further illustrated later in §4, which shows that the same logic applies in an analysis of a different case of countershifting involving reduplication rather than stress. The result is the countershifting generalization in (1).

The derivation is not yet complete. After [CV(CV́CV)] has been selected as the output of Step I, the grammar must now ensure that APOCOPE applies in Step II, despite making penultimate stress non-surface-true. Given the logic of OT, the challenge in Step II is easy to address, since penultimate-stress assignment can be interpreted as a violable preference. Penultimate stress will be the default, but final stress will be tolerated in order to satisfy a higher-ranked restriction against word-final vowels. More concretely, we can decompose STRESS! along the lines of McCarthy's (2008) analysis of stress-syncope opacity. In particular, STRESS! can be decomposed into a constraint like HAVEFOOT!, which requires any foot structure,[8] as well as various constraints regarding properties of this structure, such as ALIGNR, which requires a foot to be aligned to the right edge of the prosodic word, TROCHEE (omitted from the tableaux below for space), which requires a foot to be trochaic, and FTBIN, which requires a foot to be binary. The violable preference for penultimate stress can be represented by ranking FTBIN below *V#. Tableau (11) below repeats Step I with the new set of constraints, and tableau (12) shows that Step II yields the desired output [CV(CV́C)]. In Step III, shown in (13), the derivation will converge on [CV(CV́C)] (candidate (a)) despite its violation of the markedness constraint FTBIN. On the assumption that GEN does not have a stress-shifting operation, candidates like candidate (b) cannot be generated. Stress can only move as a result of a combination of two operations: foot removal and foot (re-)assignment (Elfner 2016:8). Since foot removal (candidate (c)) would incur a violation of the highest-ranked HAVEFOOT!, there is no way to shift stress to the penultimate position to satisfy FTBIN, and the correct candidate with final stress wins.

[8]The constraint labels adopted by McCarthy have been replaced here for the simplicity of exposition. See McCarthy's paper for analogous constraints with different labels and some conceptual justification.

(11) Countershifting, Step I

		/CVCVCV/	HAVEFOOT!	ALIGNR	*V#	FTBIN	MAX	IDENT[stress]
a.	☞	CV(CV́CV)			*			*
b.		CVCVC	*!				*	

(12) Countershifting, Step II

		/CV(CV́CV)/	HAVEFOOT!	ALIGNR	*V#	FTBIN	MAX	IDENT[stress]
a.		CV(CV́CV)			*!			
b.	☞	CV(CV́C)				*	*	

(13) Countershifting, Step III

		/CV(CV́C)/	HAVEFOOT!	ALIGNR	*V#	FTBIN	MAX	IDENT[stress]
a.	☞	CV(CV́C)				*		
~~b.~~		~~(CV́CVC)~~						~~*~~
c.		CVCVC	*!					*

Note that Step I, in which the opaque process applied, was successful directly due to the countershifting status of the interaction. However, I have not provided a general characterization of the success of HS in Step II and Step III, which relied on a specific decomposition of the markedness constraint responsible for stress. This leaves open the possibility that these steps might behave differently in other countershifting interactions. For example, in §4 we will see an analysis of countershifting opacity involving reduplication in which Steps II and III are completely trivial once the opaque process has applied in Step I and no decomposition of the markedness constraint is needed. Since it is also conceivable that HS would fail on Step II or III in currently-unknown countershifting interactions, (1) is given as a narrow statement about the application of the opaque process rather than a general statement about the success of HS on complete countershifting interactions.

3.4 Non-canonical counterbleeding is not countershifting

According to McCarthy (2000, p. 13), HS can account for counterbleeding opacity in a limited set of cases with special properties. In this section, I present McCarthy's example of such cases and note that it is meaningfully different from countershifting.

McCarthy's example is a hypothetical interaction, suggested by Alan Prince, where a process of post-vocalic spirantization applies while a later deletion process removes its triggering vowel. What allows HS to succeed on this interaction is a decomposition of deletion into a two-step process involving first the deletion of the segment's featural content (reduction) and then its autosegmental V slot (ə-syncope), as shown in (14).

(14)

UR	/darabat/
Post-vocalic Spirantization	daravat
Vowel Reduction	darəvat
Syncope of ə	darvat

Here, post-vocalic spirantization is triggered by any vowel, featureless or not. This interaction is not a canonical counterbleeding interaction in the sense that the later process (ə-syncope) that has the potential to bleed an earlier process (spirantization) cannot apply to the input without the help of a third process (reduction). Neither is this a countershifting interaction, because no process has the potential to shift any other.

On the assumption that full deletion is not a GEN operation, the deletion process that can bleed post-vocalic spirantization cannot apply in Step I and simultaneously satisfy the markedness constraints that trigger both processes, here *Vb (for spirantization), REDUCE (reduction), and *ə (empty-vowel deletion). The effect of this restriction on GEN is highlighted in tableau (15), where the otherwise-generable candidate (b), which would have satisfied all markedness constraints, is struck out. The correct candidate (a) is selected in Step I and the problem discussed in §3.2 for counterbleeding is avoided (see McCarthy 2000, pp. 13–16 for the full story). The HS analysis of a different counterbleeding interaction in Torres-Tamarit (2016) uses a similar strategy.

(15) Non-canonical counterbleeding, Step I

		/darabat/	*Vb	REDUCE	MAX-PLACE	IDENT[cont]	*ə
a.	☞	daravat		*!		*	
~~b.~~		~~darbat~~			~~*~~		
c.		darəbat	*!		*		*

This example illustrates that the reported success of HS on some counterbleeding interactions relies on a decomposition of the two interacting processes rather than on similarities between the interaction and countershifting, further supporting the distinction between countershifting and counterbleeding.

4 The generality of countershifting opacity

4.1 Attested cases of countershifting opacity

Countershifting opacity can arise with persistent processes that apply no matter what, even if their original context is modified. As we have seen, this includes stress, which in many languages necessarily applies in every word. Other relevant processes include reduplication in morphophonology, which can obligatorily realize reduplicative morphemes, and agreement-type processes like nasal-place assimilation (though I have yet to find an attested case involving the latter).[9] Here is a short list of attested countershifting interactions.

Elfner (2016) presented HS analyses of multiple languages with opaque stress-epenthesis interactions. In Dakota (Shaw 1985), for example, stress falls on the second syllable of the word, except if the second vowel is epenthetic, in which case stress is initial (16a). In Syrian Arabic (Kiparsky 2015), stress is assigned to the final syllable if and

[9] A hypothetical example of countershifting involving agreement is the following: a process of nasal-place assimilation changes the place of articulation of an underlying velar nasal to the place of articulation of the following stop, and another process turn /p/ to [t] word-finally. This results in countershifting interactions like the following: /ŋp#/ → mp# → [mt#]. Here, a reverse order of application would have derived [nt#].

only if it is super-heavy. On the surface, however, stress also falls on a heavy syllable derived from an underlying super-heavy syllable through degemination (16b). In Alsea (Buckley 2008), which will be analyzed below, a reduplication process that copies the initial C(C)V portion of the stem becomes opaque through syncope, which deletes the stem's vowel (16c). If the countershifting generalization is correct, we would expect HS to be able to correctly apply the opaque processes in all of these cases, even when they seem quite different from the stress-apocope interaction analyzed in §3. Elfner (2016) has already shown this to be true for stress-epenthesis interactions. In the next section, I will illustrate this using opaque reduplication in Alsea (16c).[10]

(16) a. Epenthesis countershifts stress in Dakota (Shaw 1985, Elfner 2016)

/čap/ → čáp → [čápa] 'beaver'

b. Degemination countershifts stress in Syrian Arabic (Kiparsky 2015)

/bi-mədd/ → bimə́dd → [bimə́d] 'he spreads, extends'

c. Syncope countershifts reduplication in Alsea (Buckley 2008)

/CV-ciq^w-i/ → ci-ciq^w-i → [ci-cq^w-i] 'always laughing'

4.2 Analysis of reduplication-syncope countershifting in Alsea

This section provides a proof-of-concept analysis of countershifting involving reduplication in Alsea (formerly spoken in central Oregon, USA). Its goal is to illustrate that

[10]In addition to the attested types of interaction listed here, we have seen that HS can generate opaque stress-deletion interactions, as in the hypothetical example presented in §2 and analyzed in §3.3. As mentioned in the introduction, McCarthy (2008) has already shown that HS can generate certain opaque stress-syncope interactions. One example comes from Macushi Carib, where bisyllabic iambic feet are assigned from left to right. Then, syncope deletes the vowel of the weak syllable in every foot. The result is derivations like (i).

(i) Syncope almost countershifts stress in Macushi Carib (McCarthy 2008)
/wanamari/ → (wanàː)(maríː) → (wnàː)(mríː) 'mirror'

This interaction bears some resemblance to countershifting, because if the same vowels had been deleted before stress assignment, the result would have been a different stress pattern. Nevertheless, it does not meet the definition of countershifting in (5), because if stress-sensitive syncope applied first, the footless input would not have provided its context of application, so (4a) would not have been met. This state of affairs is familiar from the type of interaction that Baković (2007) calls "self-destructive feeding", where a feeding interaction results in opacity. I leave it for future research to better understand the classification of McCarthy's example and to determine whether there are attested stress-deletion interactions that meet the definition of *countershifting* in (5).

once an interaction is identified as countershifting, an HS analysis is readily available using the logic of §3, even when stress is not involved.

According to Buckley's (2008) description of reduplication patterns in Alsea, one type of reduplication involves a prefix that copies the following C(C)V syllable-portion from the stem. A process of syncope deletes the stem's vowel in certain morphosyntactic environments independently of reduplication (cx̣^{w}t-ay-x̣ 'began to fight' vs. cx̣^{w}a̱t-iyu 'fighting'; cx^{w}t-t 'push him!' vs. ci̱x^{w}t-an-x̣ 'pushed him'). Reduplication is made opaque by syncope: In (17) below, the two examples in (a) illustrate the regular application of reduplication in an environment where syncope does not apply. In (b)-(d), a CV syllable is reduplicated, even though the copied vowel of the stem is deleted by syncope (the syncopated vowel can be seen in the non-reduplicated basic forms).

(17)

	Reduplicated		Basic	
a.	**tqi-tqiɬ**-i-tx̣	'are crying'	**tqiɬ**-iy-m	'they (will) cry'
b.	**ɬu-ɬt**-sx̣-aw-t	'swimming, diving'	**ɬut**-sx̣-a	'swims (often)'
c.	**ci-cq^{w}**-i	'always laughing'	**ciq^{w}**-iy-x̣	'began to laugh'
d.	**pa-pltk^{w}**-t'	'chair'	**paltk^{w}**-x̣	'sit down!'

These alternations suggest an ordering of reduplication before syncope and a countershifting interaction. Applying syncope first would not have fed or bled reduplication but would have rather caused it to copy different phonological material: presumably, for example, applying syncope first to 'always laughing' in (c) would have resulted in the mapping /RED-ciq^{w}-i/ $\rightarrow$ [cq^{w}i-cq^{w}-i]. Similar countershifting interactions in the related language Klamath have been discussed in Barker 1964, Clements and Keyser 1983, McCarthy and Prince 1995, and Zoll 2002.

Assuming a templatic theory of reduplication in HS along the lines of McCarthy et al. (2012), and following the reasoning of the HS analysis of countershifting in §3, a proof-of-concept HS analysis of the Alsea interaction will work as follows. Abstracting away from the details of McCarthy et al.'s theory, reduplication will be triggered by the syllabic template $\sigma_{[CV]}$, which needs to be filled by a (potentially complex) onset and a vowel. The constraint that requires filling the template will be FILLTEMPLATE!. The copying operation that fills templates violates the faithfulness constraint *COPY. Syncope will be triggered by the simplified $^{*}\mathrm{V}_{\mathrm{STEM}}$. In Step I, the copying candidate is correctly selected. Given the countershifting nature of the interaction, candidate (b) fatally violates the constraint that triggers reduplication. In Step II, nothing special needs to be said and the correct output candidate wins. Since all markedness constraints are satisfied, the derivation will converge in Step III (not shown).

(18) Alsea countershifting, Step I

/$\sigma_{[CV]}$-ciq^{w}-i/	FILLTEMPLATE!	$^{*}\mathrm{V}_{\mathrm{STEM}}$	MAX	*COPY
a. ☞ ci-ciq^{w}-i		*		*
b. $\sigma_{[CV]}$-cq^{w}-i	*!		*	

(19) Alsea countershifting, Step II

/ci-ciq^{w}-i/	FILLTEMPLATE!	$^{*}\mathrm{V}_{\mathrm{STEM}}$	MAX	*COPY
a. ci-ciq^{w}-i		*!		
b. ☞ ci-cq^{w}-i			*	

5 Conclusion

This note makes two contributions. The first, which is not theoretically significant in and of itself, is the introduction of the new terms *shifting* and *countershifting*. While shifting interactions have already been identified in the literature (under the name *transfusions*; Zwicky 1987), the term countershifting fills a gap in the traditional taxonomy of pairwise process interactions. The second contribution is the observation that some opaque interactions that can be generated by HS are not isolated cases but rather special cases of a general class of opaque interactions: the class of countershifting opacity. The identification of countershifting opacity, together with the logic concerning the ability of HS to deal with countershifting interactions in general, constitutes progress in our evaluation of HS as a theory of opacity. This result raises questions that I have not been able to address in the scope of this note, such as: can HS generate any countershifting interaction or is it limited to interactions with certain properties? What is the broader typology of countershifting, and what is the range of processes that can participate in countershifting interactions? Further research into countershifting will hopefully reveal the answers to these questions.

References

Al-Mozainy, Hamza Qublan. 1981. Vowel alternations in a Bedouin Hijazi Arabic dialect: Abstractness and stress. Doctoral Dissertation, University of Texas at Austin.

Baković, Eric. 2007. A revised typology of opaque generalisations. *Phonology* 217–259.

Baković, Eric. 2011. Opacity and ordering. In *The handbook of phonological theory, second edition*, 40–67. Wiley-Blackwell.

Baković, Eric, and Lev Blumenfeld. 2019. Rule interaction conversion operations. *Loquens* 6:e062.

Barker, M. A. R. 1964. *Klamath grammar*. Berkeley and Los Angeles: University of California Press.

Buckley, Eugene. 2008. Alsea reduplication and phonological opacity. Paper presented at the Meeting of the Society for the Study of the Indigenous Languages of the Americas, Chicago, January 3-6. Retrieved on May 16, 2020 from `http://www.ling.upenn.edu/~gene/papers/Alsea_reduplication.pdf`.

Clements, G. N., and Samuel Jay Keyser. 1983. *CV phonology: A generative theory of the syllable.*. Cambridge MA: MIT Press.

Elfner, Emily. 2016. Stress-epenthesis interactions in Harmonic Serialism. In *Harmonic Grammar and Harmonic Serialism*, 261–300. Equinox, Sheffield.

Kiparsky, Paul. 1968. How abstract is phonology? Indiana University Linguistics Club.

Kiparsky, Paul. 1971. Historical linguistics. In *A survey of linguistic science*, ed. W. O. Dingwall, 576–642. University of Maryland Linguistics Program, College Park.

Kiparsky, Paul. 2015. Stratal OT: A synopsis and FAQs. In *Capturing phonological shades within and across languages*, ed. Yuchau E. Hsiao and Lian-Hee Wee, 2–44. Cambridge Scholars Publishing.

McCarthy, John. 2000. Harmonic serialism and parallelism. In *Proceedings of the North East Linguistic Society*, ed. Masako Hirotani, Andries Coetzee, Nancy Hall, and Ji-yung Kim, 501–524. Rutgers University: Graduate Linguistic Student Association.

McCarthy, John. 2007. *Hidden generalizations: Phonological opacity in Optimality Theory*. London: Equinox.

McCarthy, John. 2008. The serial interaction of stress and syncope. *Natural Language & Linguistic Theory* 26:499–546.

McCarthy, John, and Alan Prince. 1995. Faithfulness and reduplicative identity. In *Papers in optimality theory*, ed. S. Urbanczyk J. Beckman L. Walsh Dickey, volume 18 of *University of Massachusetts Occasional papers*, 249–384. UMASS.

McCarthy, John J. 2016. The theory and practice of Harmonic Serialism. In *Harmonic Grammar and Harmonic Serialism*, 47–87. London: Equinox.

McCarthy, John J, Wendell Kimper, and Kevin Mullin. 2012. Reduplication in harmonic serialism. *Morphology* 22:173–232.

Müller, Gereon. 2020. *Inflectional Morphology in Harmonic Serialism*. In the series Advances in Optimality Theory, London: Equinox.

Newton, B. E. 1971. Ordering paradoxes in phonology. *Journal of Linguistics* 7:31–53.

Prince, Alan, and Paul Smolensky. 1993/2004. *Optimality Theory: Constraint interaction in generative grammar*. Wiley-Blackwell: Oxford.

Shaw, Patricia A. 1985. Modularisation and substantive constraints in Dakota lexical phonology. *Phonology yearbook* 2:173–202.

Torres-Tamarit, Francesc. 2012. Syllabification and Opacity in Harmonic Serialism. Doctoral Dissertation, Universitat Autònoma de Barcelona.

Torres-Tamarit, Francesc. 2016. Compensatory and opaque vowel lengthening in Harmonic Serialism. In *Harmonic Grammar and Harmonic Serialism*. Equinox, Sheffield.

Zoll, Cheryl. 2002. Vowel reduction and reduplication in Klamath. *Linguistic Inquiry* 33:520–527.

Zwicky, Arnold. 1987. Rule interactions: another gloss on K&K. *Innovations in Linguistics Education* 5:91–111.