Faith-UO: Counterfeeding in Harmonic Serialism

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1 Introduction

Cases of opacity present problems for grammars in Optimality Theory, though they can be analyzed with rule ordering. Parallel OT lacks the necessary serial framework to account for most opaque patterns. Harmonic Serialism (HS) is a serial derivative of OT which provides a derivational framework that aids in analysis of various opaque alternations (McCarthy, 2000). We propose the use of faithfulness constraints which reference the underlying representation of forms within Harmonic Serialism to account for counterfeeding opacity. These are unlike standard HS faithfulness constraints which require identity between the input and output of the current step of the derivation. By maintaining faithfulness to the underlying form throughout the derivation, contrast is emergent as in standard OT instead of a theoretical primitive as in Lubowicz (2003). This analysis predicts that all counterfeeding patterns should operate on contrastive segments only, which is observed to our knowledge.

2 Counterfeeding opacity

Counterfeeding opacity is essentially surface under-application. The environment for a rule exists, but the rule does not seem to have applied to the surface form. For two ordered rules $\mathbb{A}$ and $\mathbb{B}$, where $\mathbb{A}$ precedes $\mathbb{B}$ in order of application, $\mathbb{B}$ COUNTERFEEDS $\mathbb{A}$ iff $\mathbb{B}$ would create additional inputs to $\mathbb{A}$, but does not due to order of application.

Within counterfeeding, there are two subtypes of opacity: *counterfeeding on environment* and *counterfeeding on focus* (sometimes called *chain shifts*). An example of counterfeeding on focus is a chain shift on vowel height in Basque (Hualde & de Urbina, 2003). Mid vowels raise to high, and low vowels raise to mid, but underlying low vowels do not raise to high. The output [alabe-a] has the environment for the rule shifting mid vowels to high vowels, but the rule has not applied to the surface form. It appears as if the rule for raising has under-applied.

(1) Chain shift on vowel height - Basque
/seme-e/ $\rightarrow$ [semi-e]
/alaba-a/ $\rightarrow$ [alabe-a] $\nrightarrow$ *[alabi-a]

This chain shift is analyzed in a rule-based framework by ordering the rule requiring mid-to-high raising before the rule requiring low-to-mid raising, shown in the rule derivation below.

(2) Rule derivation - Basque

	/alaba-a/ 'daughter'	/seme-e/ 'son'
Raising [-low] $\rightarrow$ [+high]	-	semi-e
Raising [+low] $\rightarrow$ [-low]	alabe-a	-
	[alabe-a]	[semi-e]

Chain shifts are also often analyzed in terms of underlying contrast preservation as in Lubowicz (2003) and Jesney (2005). The underlying contrast between /a/ and /e/ is preserved on the surface as a contrast between /e/ and /i/.

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HS and standard OT predict /alaba-a/ → *[alabi-a], not the attested [alabe-a], as illustrated in the following tableau. The actual output [alabe-a] still violates the constraint *[-low, -hi]/_V, which outranks IDENT(hi), the constraint which prefers the intended winner.

(3) OT tableaux - Basque

a.

/seme-e/	*[+low]/_V	*[-low, -hi]/_V	IDENT(hi)	IDENT(low)
→ semi-e			*	
seme-e		*!		

b.

/alaba-a/	*[+low]/_V	*[-low, -hi]/_V	IDENT(hi)	IDENT(low)
→ *alabi-a			*	*
☹ alabe-a		*!		*
alaba-a	*!			

The two tableaux above present a ranking contradiction. The crucial ranking for [semi-e] to win in (3a) is *[-low, -hi]/_V ≫ IDENT(hi), but the crucial ranking for [alabe-a] to win in (3b) would be IDENT(hi) ≫ *[-low, -hi]/_V. Because the necessary rankings are contradictory, chain shift patterns like Basque are impossible to analyze without additional technology in OT-style grammars.

2.1 *Focus vs. environment* The example of the chain shift above is considered counterfeeding on focus, which we distinguish from counterfeeding on environment as in McCarthy (1999). In the Basque chain shift, the focused segment is the vowel undergoing the shift, which is in the same necessary environment in all cases. This contrasts with counterfeeding on environment, where the later-ordered rule creates the environment for the application of the earlier rule. Thus both types of counterfeeding result in what seems to be surface underapplication.

An example of counterfeeding on environment comes from Lomongo. Here, the application of intervocalic deletion creates the environment for gliding. Since the rule demanding gliding is ordered before intervocalic deletion, it does not apply, creating surface opacity.

(4) Lomongo: intervocalic voiced obstruent deletion counterfeeds gliding before vowels (Baković, 2011)
/o-bina/ → o-ina ↛ *w-ina
/o-isa/ → w-isa

(5) Rule derivation - Lomongo

	/o-bina/	/o-isa/
Gliding	-	w-isa
Intervocalic Deletion	o-ina	-
	[oina]	[wisa]

Our proposed faithfulness constraints can account for both counterfeeding on focus patterns and counterfeeding on environment patterns. The only necessary difference is to define a property (focus) or an environment of the UR in the FAITH-UO constraints.

3 Harmonic Serialism

HS is a serial derivative of Optimality Theory in which GEN is limited to candidates that differ from the input by only one change. The derivation is multistep, and the output of EVAL at one step is the input to the following step. HS captures some of the aspects of rule ordering with serial candidate evaluation because processes can be forced to apply before others through constraint ranking. However, counterfeeding opacity is still problematic.

An HS analysis of the Basque chain shift still fails due to a ranking contradiction, as shown in the tableaux below. Here we assume that one feature change qualifies as 'one change' between input and output.

(6) HS derivation - Basque
Step 1 /seme-e/ 'son'

/seme-e/	*[+low]/_V	*[-low, -hi]/_V	IDENT(hi)	IDENT(low)
→ semi-e			*	
seme-e		*!		

*[-low, -hi]/_V ≫ IDENT(hi)

Step 2: Convergence

semi-e	*[+low]/_V	*[-low, -hi]/_V	IDENT(hi)	IDENT(low)
→ semi-e				
seme-e		*!	*	

(7) Step 1 /alaba-a/ 'daughter'

/alaba-a/	*[+low]/_V	*[-low, -hi]/_V	IDENT(hi)	IDENT(low)
→ alabe-a		*		*
alaba-a	*!			

*[+low]/_V ≫ *[-low, -hi]/_V, IDENT(low)

Step 2: Ranking problems

alabe-a	*[+low]/_V	*[-low, -hi]/_V	IDENT(hi)	IDENT(low)
☹ alabe-a		*!		
→ *alabi-a			*	

IDENT(hi) ≫ *[-low, -hi]/_V

Although HS provides a mechanism for ordering processes through constraint ranking, counterfeeding opacity is still problematic. Our proposal accounts for these patterns within HS by incorporating a new set of faithfulness constraints, FAITH-UO constraints, which demand faithfulness to underlying representations at every stage of the derivation.

4 The Proposal

In Harmonic Serialism, faithfulness constraints typically reference the input-output mappings of the current stage of the derivation. We propose another coexistent set of faithfulness constraints which are able to reference the underlying representation at any stage of the derivation: FAITH-UO, faithfulness between the underlying representation and the output. These constraints assign violations for differences between the output of the current stage of the derivation and the original underlying representation. Faithfulness to the underlying representation has been used before in HS (McCarthy, 2007b) but not as a method of analyzing opacity.

The constraints that we propose are a set of faithfulness constraints which operate between underlying representations and outputs. The constraints are violated if and only if the output differs from the input in that property. That is, constraints of the form ID[F] require faithfulness to the property F in all segments having the property F. Thus, FAITH-UO constraints refer not only to a property of the underlying representation that is not allowed to change, but also the context that must be present in the underlying representation for the constraint to be applicable.[1]

4.1 *Defining* FAITH-UO

Our proposed set of constraints, FAITH-UO, have the following form:

(8) ID-UO(F)/[αG]
Do not change the value of F for segments that are [αG] in the underlying representation (counterfeeding on focus/chain shifts).

(9) ID-UO(F)/_[αG]
Do not change the value of F for segments that are in the environment of _[αG] in the underlying representation (counterfeeding on environment).

5 Analysis

The effect of FAITH-UO constraints is illustrated in the following analysis of Basque. The low vowel becomes mid, and the disallowed second step of the chain shift, which would raise the resulting mid vowel

[1] Faith-UO constraints are therefore non-equality-checking in the sense of Cable (2000) and Moreton (2000).

to high, is prevented by the higher ranking FAITH-UO constraint for height on segments which are [+low] in the UR.

(10) Basque (Hualde & de Urbina, 2003)
a. /alaba-a/ → alabe-a ↛ alabi-a
b. /seme-e/ → semi-e
ID-UO(hi)/[+low]

The following tableaux show the derivation for the alternation above. The low vowel becomes mid but the second step of the chain shift, from mid to high, is prevented by the implementation of the higher ranking FAITH-UO constraint for height on segments which are [+low] in the underlying representation.

(11) Step 1: /alaba-a/ → alabe-a

/alaba-a/	ID-UO(hi)/[+low]	*low/_V	*mid/_V	ID-IO(hi)
→ alabe-a				*
alaba-a		*!		

Step 2: alabe-a ↛ alabi-a:

/alaba-a/ alabe-a	ID-UO(hi)/[+low]	*low/_V	*mid/_V	ID-IO(hi)
→ alabe-a			*	
alabi-a	*!			

The tableau below shows the second case in the Basque chain shift. Underlying mid vowels do shift to high vowels before a vowel. This is permitted by our constraint set because the top ranked UO constraint only assigns violations for segments which become high if they were [+low] in the UR. Because the vowel in the underlying representation is a mid vowel, the FAITH-UO constraint is not violated and the candidate with the high vowel is the optimal candidate because the markedness constraint against mid vowels outranks the general faithfulness constraint.

(12) Step 1: /seme-e/ → semi-e

/seme-e/	ID-UO(hi)/[+low]	*low/_V	*mid/_V	ID-IO(hi)
→ semi-e				*
seme-e			*!	

The use of the FAITH-UO constraints allows the contrast preservation observed in chain shifts. Underlying vowel height contrast between /a/ and /e/ is preserved as a contrast between /e/ and /i/ in output forms.

5.1 *Further Examples* Another example of counterfeeding on focus comes from Mwera. Voiced obstruents delete after nasals, and voiceless obstruents become voiced after nasals, but underlying voiceless obstruents do not delete.

(13) Mwera (Harries, 1950): underlying voiced obstruents delete and underlying voiceless obstruents become voiced after nasals
/m-pundo/ → m-bundo ↛ *m-undo
/ŋ-gomo/ → ŋ-omo

For the Mwera data, the relevant FAITH-UO constraint is MAX-UO/[-voice]. This constraint prevents deletion of segments which were voiceless in the underlying representation. Because it is ranked above the relevant markedness constraints, the problematic candidate *[m-undo] which undergoes both voicing and deletion cannot win.

(14) Step 1: /m-pundo/ → m-bundo

/m-pundo/	MAX-UO/[-voice]	*[nas][-voice]	*[nas][+voice]	ID-IO(voice)	MAX-IO
→ m-bundo			*	*	
m-pundo		*!			
m-undo	*!				*

Step 2: Convergence

/m-pundo/ m-bundo	MAX-UO/[-voice]	*[nas][-voice]	*[nas][+voice]	ID-IO(voice)	MAX-IO
→ m-bundo			*	*	
m-pundo		*!			
m-undo	*!				*

Below, we provide additional examples of cases of CF on focus (the same pattern as in Basque and Mwera) but involving different phonological processes. Relevant FAITH-UO constraints are given below and are generalizable to other types of counterfeeding.

(15) Finnish (Lubowicz, 2003): /a/ rounds to [o] and /aa/ shortens to /a/ before /-i/, underlying /aa/ doesn't round to [o]
/vapaa-ina/ → vapa-ina ↛ *vapo-ina
/vapa-ina/ → vapo-ina

ID-UO(rd)/[+long] ≫ *[+long]/_i ≫ *[-round]/_i, ≫ ID-IO(round), ID-IO(long)

(16) Bedouin Arabic (Al-Mozainy, 2007): low vowels raise and high vowels delete in open syllables, underlying low vowels don't delete
/dafaʕ/ → difaʕ ↛ *dfaʕ
/ʃaribat/ → ʃarbat

MAX-UO/[+low] ≫ *[+low]/_$]_\sigma$ ≫ *[+hi]/_$]_\sigma$ ≫ ID-IO(hi), MAX-IO

5.2 *Multi-step chain shifts* FAITH-UO constraints are also able to account for multi-step chain shifts by incorporating multiple FAITH-UO constraints for the disallowed steps in the chain shift. An example of a three step chain shift is given in (17).

(17) Nzebi: low vowels raise to mix lax, mid lax vowels raise to mid tense, mid tense vowels raise to high (Kirchner, 1996)
/sal/ → sɛl ↛ sel ↛ sil
/bɛd/ → bed ↛ bid
/bet/ → bit

The first FAITH-UO constraint needed is ID-UO(ATR)/[+low], which requires faithfulness to the feature ATR in segments which are [+low] in the underlying representation. This constraint will prevent the low vowel in /sal/ from raising past the desired [sɛl]. Since [ɛ] and [a] are both [-ATR], ID-UO(ATR)/[+low] is not violated when [a] becomes [ɛ]. As the constraint would be violated by raising [a] to [e] or [i], this constraint prevents the undesired chain shift steps.

The second constraint, ID-UO(hi)/[-ATR], prevents raising underlying [ɛ] to [i]. This constraint requires faithfulness to the feature [high] in segments which are [-ATR] in the underlying representation. Therefore, the [ɛ] → [e] change does not incur a violation since there is no change in the value of [-hi]. The further shift [e] → [i] would incur a violation because there is a change in height from the corresponding [-ATR] segment in the underlying representation.

The two constraints needed to account for this multi-step chain shift are unranked with respect to each other because they are both unviolated throughout the derivation, but they follow the generalized ranking for chain shifts given in (24). The FAITH-UO constraints must outrank the relevant markedness constraint(s) and general faithfulness constraints. Neither of these constraints will prevent the desired last step of the chain shift from /e/ → [i]. Underlying /e/ is neither [+low] nor [-ATR] so the FAITH-UO constraints will not be violated. For space purposes, we use the constraint RAISE as a placeholder and conjunction of the group of constraints demanding raising from /a/ to [i].

(18) Step 1 of /sal/ → sɛl ↛ sel ↛ sil

/sal/	ID-UO(ATR)/[+low]	ID-UO(hi)/[-ATR]	RAISE	ID-IO(hi)	ID-IO(ATR)
→ sɛl			**		
sal			***!		
sel	*!		*		*

(19) Step 2 of /sal/ → sɛl ↛ sel ↛ sil

/sal/ sɛl	ID-UO(ATR)/[+low]	ID-UO(hi)/[-ATR]	RAISE	ID-IO(hi)	ID-IO(ATR)
→ sɛl			**		
sel	*!		*		*
sil	*!	*		*	*

Here, the output converges on [sɛl]. The candidate [sel] loses by violating a FAITH-UO constraint, and the candidate [sil] that raises further is harmonically bounded. This aspect of the analysis captures faithfulness to the underlying form as the mechanism behind chain shift patterns, the purpose behind implementation of FAITH-UO constraints. The more steps which separate a candidate from the original underlying form, the more violation marks it acquires on the FAITH-UO constraints.

6 Analysis: CF on environment

FAITH-UO constraints can also analyze counterfeeding on environment by specifying an environment in the UR instead of a single segment. The environment need not be dependent on a binary feature necessarily, but it must be a property of the UR which can be referenced by the constraint. Below we provide an example of counterfeeding on environment from Lomongo and the relevant FAITH-UO constraints.

(20) Lomongo: intervocalic deletion counterfeeds gliding before vowels (Bakovic, 2010)
/o-bina/ → o-ina ↛ *w-ina
/o-isa/ → w-isa
ID-UO(voc)/_[+voi,−son]: Do not change the value of [α vocalic] for segments that occur before [+voi,−son] in the UR.

In step 2 of the following derivation, the FAITH-UO constraint is violated by the problematic candidate [wina], making the actual output [oina] the winner.

(21) Step 1: /o-bina/ → o-ina

/o-bina/	ID-UO(syll)/_[+voi,−son]	*[+voi,−son]/V_V	*HIATUS	MAX	ID(syll)
→ o-ina			*	*	
o-bina		* !			

Step 2: o-ina ↛ *w-ina

/o-bina/ o-ina	ID-UO(syll)/_[+voi,−son]	*[+voi,−son]/V_V	*HIATUS	MAX	ID(syll)
→ o-ina			*		
w-ina	* !				*

(22) Step 1: /o-isa/ → w-isa

/o-bina/	ID-UO(syll)/_[+voi,−son]	*[+voi,−son]/V_V	*HIATUS	MAX	ID(syll)
→ w-isa					*
o-isa			* !		

7 Generalized constraint ranking and typology

In all the cases we have examined, the same basic constraint ranking can be used to analyze patterns of counterfeeding on environment and on focus. The general form of this constraint ranking is summarized in (23).

(23) FAITH-UO >> MARKEDNESS >> FAITH-IO

This is the only ranking which produces a different pattern when added to the set of existing constraints. Adding FAITH-UO constraints to CON allows for the analysis of counterfeeding opacity without predicting the existence of other unattested patterns through factorial typology. FAITH-UO constraints only add one language to the typology because there is only one ranking (the one in (23)) where the FAITH-UO constraint crucially determines the winner. In all other ranking scenarios, either the faithful language (UR forms are the same as surface forms) or the harmonic language (markedness constraints are not violated on the surface) is produced, which both occur in the typology without FAITH-UO constraints.

In this typology, we assume that the markedness and FAITH-IO constraints are ranked as a group for expositional purposes. If free ranking of each individual constraint is allowed it is still the case that adding a FAITH-UO constraint only adds one language to the typology.

(24) Constraint rankings and their resulting languages:

FAITH-UO ≫ Markedness ≫ FAITH-IO	counterfeeding
FAITH-UO ≫ FAITH-IO ≫ Markedness	faithful
FAITH-IO ≫ Markedness ≫ FAITH-UO	faithful
FAITH-IO ≫ FAITH-IO ≫ Markedness	faithful
Markedness ≫ FAITH-IO ≫ FAITH-UO	harmonic
Markedness ≫ FAITH-UO ≫ FAITH-IO	harmonic

8 Implications

FAITH-UO constraints permit the analysis of counterfeeding opacity in Harmonic Serialism by requiring faithfulness to a particular property 'A' in a particular class of segments 'B'. One resulting effect of these constraints is that, because they require faithfulness to a feature of the underlying representation which may or may not be present in the output form, they effectively require preservation of an underlying contrast. Thus, contrast preservation is an emergent property of a system with FAITH-UO constraints.

A prediction resulting from FAITH-UO constraints is that there should be no chain shifts which manipulate non-contrastive features in a language, such as stress (in some cases), allophonic alternations, or syllable structure, since these elements are not present in the underlying representation. An example of this would be a case like the Basque chain shift (shown in (1)) which only shifts stressed vowels in a language which lacks lexical stress. To our knowledge, this type of chain shift is not observed.

Because our constraints require faithfulness to the underlying form and not other intermediate stages of the derivation, counterfeeding opacity is inherently linked to contrast preservation.

8.1 *Previous Work* Counterfeeding opacity has been analyzed in other serial OT frameworks. In the phonology of contrast (Lubowicz, 2003), chain shifts are analyzed through constraints which specifically demand contrast preservation. Entire sets of input-output mappings (scenarios) are evaluated by the constraints. In our account, contrast is emergent and does not need to be demanded by the grammar, or accounted for in a separate grammatical framework.

OT with candidate chains (McCarthy, 2007a) also uses a serial OT framework to analyze opacity. Candidates consist of chains of each output form from each step of the derivation. Our approach differs in that it is more local, because it only requires access to the underlying form and not intermediate forms.

9 Conclusion

We have proposed a new set of constraints within the Harmonic Serialism framework to account for counterfeeding opacity. These FAITH-UO constraints demand faithfulness to the underlying representation at all stages of the derivation. These constraints have accounted for counterfeeding patterns in several languages and have the potential to provide a comprehensive account of all counterfeeding patterns cross-linguistically.

If counterfeeding is the result of the domination of FAITH-UO constraints over general markedness and faithfulness constraints, we predict that chain shifts should only operate on contrastive segments. To our knowledge, this prediction is observed.

In our analysis, contrast is derived from constraint interaction. By using FAITH-UO constraints, we do not require a primitive notion of contrast or a separate grammatical framework to account for counterfeeding patterns which reference contrast. FAITH-UO constraints cause contrast preservation by demanding faithfulness to the underlying form.

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