Interacting Processes in OT

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1 Interacting Phonological processes

Phonological processes can interact. The types of interaction have been classified in five ways:

1. No interaction
2. Feeding
3. Bleeding
4. Counterfeeding
5. Counterbleeding

Patterns describable with feeding and bleeding rule interactions are often called **transparent**, whereas patterns describable with counterfeeding and counterbleeding rule interactions are called **opaque** (Kiparsky, 1971, 1973; Baković, 2007; Baković, 2011).

1.1 Noninteraction

Consider the alternations shown below in Zoque (Wonderly, 1951; Padgett, 1995). (See also Kenstowicz and Kisseberth (1979, p. 35).) Let's assume the first person prefix is /n-/.

	Noun	my Noun	gloss		Noun	my Noun	gloss
a.	pama	mbama	'clothing'	e.	tatah	ndatah	'father'
b.	burro	mburru	'burro'	f.	disko	ndisko	'record'
c.	tsima	ndzima	'calabash'	g.	kaju	ŋgaju	'horse'
d.	ʧoʔngoja	ɲʤoʔngoja	'rabbit'	h.	gaju	ŋgaju	'rooster'

1.2 Feeding

One phonological process **feeds** another if it creates the environment so that another process applies.

Here is an example from Guinaang Kalinga, which is a dialect of Lubuagan Kalinga, an Austronesian language from the Philippines with 12,000-15,000 speakers. Assume that there are lots of examples like (a), where the first stem vowel is not unstressed [o].

a)	dábo	(hypothetical)	d**in**ábo	(hypothetical)
b)	dopá	'fathom'	d**im**pána	'he measured by fathom'
c)	gobá	'firing (pots)'	g**im**bána	'she fired'
d)	ʔomós	'bath'	ʔ**im**m'osna	'she bathed'
e)	botáʔ	'broken piece'	b**in**táʔna	'she broke'
f)	ʔodáw	'requesting'	ʔ**in**dáwna	'he requested'
g)	bosát	'sudden break'	b**in**sátna	'he snapped'
h)	ponú	'filling'	p**in**núna	'she filled'
i)	toʔóp	'satisfaction'	t**in**ʔópna	'he satisfied'
j)	sogób	'burning'	s**iŋ**góbna	'he burned'
k)	doŋól	'report'	d**iŋ**ŋólna	'he heard'
l)	ʔolót	'tightening'	ʔ**il**lótna	'he made tight'
m)	ʔowá	'doing, making'	ʔ**iŋ**wána	'he made, did'

1.3 Bleeding

A process is said to *bleed* another process if prevents the other process from occuring (by changing the environment so that the other one no longer applies). In this case the first process can be thought to have priority over the second one.

(1) Example: English plural

pi-z	'peas'
tʰoʊ-z	'toes'
dɑl-z	'dolls'
pʰæn-z	'pans'
dɑg-z	'dogs'
læb-z	'labs'
kʰɪln-z	'kilns'
kʰæsp-s	'clasps'
mɪt-s	'mitts'
bloʊk-s	'blokes'
kʰɑf-s	'coughs'
glas-ɪz	'glasses'
fɪz-ɪz	'fizzes'
bɹænʃ-ɨz	'branches
bædʒ-ɪz	'badges'
wɪʃ-ɪz	'wishes'
gəɹɑʒ-ɪz	'garages'

1.4 Counterfeeding opacity

Two processes are in a **counterfeeding** interaction if it is the case that one process could have fed the other, but in fact it does not.

Here is an example from Palauan, an Austronesian language from the Republic of Palau with about 15,000 speakers.

	X	*his/her/its X*	
a)	ɾákt^{h}	ɾəkt-ɛ́l	'sickness'
b)	sɛ́səb	səsəb-ɛ́l	'fire'
c)	bótk^{h}	bətk-ɛ́l	'operation'
d)	ɾíŋəl	ɾəŋəl-ɛ́l	'pain'
e)	kúk-	kəkú-l	'nail'
f)	ɾɛ́ːk^{h}	ɾɛk-ɛ́l	'rustling sound'
g)	ðəkóːl	ðəkol-ɛ́l	'cigarette'
h)	ʔíːs	ʔis-ɛ́l	'escape'
i)	búːʔə	buʔ-ɛ́l	'betel nut'

1.5 Counterbleeding opacity

Two processes are in a **counterfeeding** interaction if it is the case that one process could have bled the other, but in fact it does not.

Polish, an Indo-European language from Poland with about 43 million speakers, presents a classic example.

	sg.	*pl.*	
a)	trup	trupi	'horse'
b)	wuk	wuki	'bow'
c)	snop	snopi	'sheaf'
d)	kot	koti	'cat'
e)	nos	nosi	'nose'
f)	sok	soki	'juice'
g)	klup	klubi	'club'
h)	trut	trudi	'labor'
i)	grus	gruzi	'rubble'
j)	wuk	wugi	'lye'
k)	dvur	dvori	'mansion'
l)	bul	bole	'ache'
m)	pokuj	pokoji	'room'
n)	stuw	stowi	'table'
o)	z̨ur	z̨uri	'a kind of sour soup'
p)	ul	ule	'beehive'
q)	vuj	vuje	'uncle'
r)	muw	muwi	'mule'
s)	z̨wup	z̨wobi	'crib'
t)	lut	lodi	'ice'
u)	vus	vozi	'cart'
v)	ruk	rogi	'horn'

Patterns which can be described with a counterbleeding rule interaction are also said to exhibit *overapplication*. In counterbleeding interactions, both rules get to apply.

2 OT and phonological interactions

OT is a theory of constraint interaction, and in phonology the constraints have been divided into two types: Markedness and Faithfulness. As we will see, this theory of optimality has no trouble accounting for the feeding and bleeding interactions (the transparent ones). However, difficulties arise when trying to account for the opaque interactions (counterbleeding and counterfeeding). These problems have led to some proposed variants for OT.

The main reason why counterfeeding and counterbleeding are problematic for OT is that they involve underapplication and overapplication. In OT, the optimal candidate is always the one that avoids the marked structures by violating the least important faithfulness constraints as possible. So this theory in general predicts neither underapplication nor overapplication.

Finally, we will see that there are individual processes that are also problematic for OT because the process appears again to do more than necessary to repair a marked structure

(overapplication). Following Bruce Hayes, I refer to this type as **saltation**. Here is a quick example to whet your appetite:

/p/ → [β], where [b] would be fine.

2.1 Transpararent Rule orderings in OT

2.1.1 Rule A "feeds" Rule B

Recall the example from Guinaang Kalinga, where syncope feeds nasal place assimilation. For example /s-in-ogób-na/ → [siŋgóbna].

		/s-in-ógob-na/
Syncope	$\breve{V} \longrightarrow \varnothing$ / VC ___ CV	singób-na
NPA	$[+\text{nasal}] \longrightarrow [\alpha \text{ place}]$ / ___ $\begin{bmatrix} -son \\ \alpha\text{place} \end{bmatrix}$	siŋgób-na

In OT, vowel deletion in the environment of VC___ CV has been explained by a pressure to shorten words while avoiding complex onsets and codas.

***Syllable** Words have fewer syllables. Assign a violation for each syllable in a word.

***Complex** Complex onsets and codas are avoided. Assign a violation for each complex onset and coda.

Max-V Don't delete vowels. Assign a violation for each vowel in the underlying form which has no corresponding vowel in the surface form.

Crucially, *COMPLEX outranks *SYLLABLE, which outranks MAX-V. (ID(PLACE) is mentioned below.)

	/s-in-ogob-na/	*Complex	*Syllable	Max-V	ID(place)
a.	si.no.gob.na		****!		
b.	sno.gob.na	*!	***	*	
c. ☞	siŋ.gob.na		***	*	*
d.	si.nog.bna	*!	***	*	*
e.	snog.bon	*!	**	**	*

Nasal Place assimilation is essentially captured with the following two constraints.

Agree-NC Nasal-consonant clusters must agree in place features. Assign one violation for each nasal consonant cluster which has a different

ID(place) Assign one violation for each consonant whose place features in the underlying form differ from its place features in the surface form. (Note place here is a convenient abbreviation for features [CORONAL,DORSAL,LABIAL].

Crucially AGREE-NC outranks ID(PLACE).

★ Let's work out what happens when all of these are put together.

★ Any other candidates (and constraints) we should consider to complete the analysis?

2.1.2 Rule A "bleeds" Rule B

Recall our analysis of the English plural where epenthesis bleeds voice assimilation.

		/brænt͡ʃ+z/
Epenthesis	$\varnothing \longrightarrow$ ɪ / [+strident] ____ [+strident]#	brænt͡ʃɪz
Voice assimilation	[-son] $\longrightarrow$ [α voice] / $\begin{bmatrix} -son \\ \alpha voice \end{bmatrix}$ ____	—

★ If Voice Assimilation had applied first, what would have happened?

Bleeding is also easy in OT. If we can satisfy both markedness constraints by making just one change, then there's no need to make 2 changes:

	/brænt͡ʃ+z/	*[+str][+str]#	* [−son, αvoice] [−son, −αvoice]	DEP-V	IDENT (VOICE)
doubly bad because of *t͡ʃz*	brænt͡ʃz				
devoicing solves only one problem	brænt͡ʃs				
☞ epenthesis solves both problems	brænt͡ʃɪz				
gratuitous voicing change	brænt͡ʃɪs				

2.2 Counterfeeding

Recall that in Palauan, unstressed vowels reduce. Long vowels shortened and short vowels reduced to schwa. For example /ʔiːs-él/ surfaces as [ʔis-él] and /sɛsəb-él/ surfaces as [səsəb-él].

	/ʔiːs-él/
Reduction V̆ ⟶ ə	—-
Shortening V̆ː ⟶ [-long]	ʔis-él

★ If B had applied first, what would have happened?

The following three markedness constraints penalize unstressed vowels of different types.

***Unstressed Long Vowel** Avoid unstressed long vowels. Assign one violation for each unstressed long vowel.

***Unstressed Short Vowel** Avoid unstressed short vowels. Assign one violation for each unstressed short vowel. Note we consider schwa to be "extra-short" and so it would not violate *UNSTRESSED SHORT VOWEL.

***Unstressed Schwa** Avoid unstressed schwas. Assign one violation for each unstressed schwas. (This is included for completeness; it appears to be low ranked in most languages.)

The relevant faithfulness are shown below.

***ID(long)** Don't change the feature LONG.

***ID(place)** This constraint is an abbreviation for the features HIGH,LOW,TENSE,BACK which have to change in order for vowels to become schwa.

Clearly *UNSTRESSED SHORT VOWEL outranks both *UNSTRESSED SCHWA and *ID(PLACE).

/sɛsəb-ɛ́l/	*V̆	*Schwa	ID(place)
a. sɛsəb-ɛ́l	*!		
b. ☞ səsəb-ɛ́l		*	*

Similarly, *UNSTRESSED LONG VOWEL outranks both *UNSTRESSED SHORT VOWEL and *ID(LONG).

/ʔiːs-ɛ́l/	*V̆ː	*V̆	ID(long)
a. ʔiːs-ɛ́l	*!		
b. ☞ ʔis-ɛ́l		*	*

Counterfeeding is hard to do in OT. If making one change (shortening) creates a problem (*UNSTRESSED SHORT VOWEL) that is normally not tolerated, that problem should get solved by making another change (reducing to schwa).

★ What happens when we consider the candidate [ʔəs-ɛ́l] in the previous tableaux?

Patterns like these, where $a \rightarrow b$ and $b \rightarrow c$, but $a \not\rightarrow c$, are often called *counterfeeding chains*.

2.3 Counterbleeding

Polish exhibited processes of final obstruent devoicing and o-raising before voiced word-final consonants.

	/kot/	/trud/	/dvor/	/voz/
o-raising o ⟶ [+high] / ___ [+voice,+cons]#	—-	—-	dvur	vuz
Devoicing [-son] ⟶ [-voice] #	—-	trut	—-	vus

In OT, ranking *VOICEOBS# above ID(VOICE) accounts for the devoicing phenomenon.

/trud/	*VoiceObs#	ID(voice)
a. trud	*!	
b. ☞ trut		*

The process of o-raising is accounted for similarly.

/trud/	*oVoiceC#	ID(high)
a. dvor	*!	
b. ☞ dvur		*

Counterbleeding is hard to do in OT—we get the wrong winner, because if one change (devoicing) can solve both problems, the other change (o-raising) has no reason to apply.

	/voz/	*VoiceObs#	*oVoiceC#	ID(VOICE)	ID(HIGH)
doubly bad	voz	*(!)	*(!)		
o-raising fixes only one problem	vuz		*!		*
devoicing fixes both problems	☞ vos			*	
apparently gratuitous raising change	♠ vus			*	*!

2.4 Interim Summary

The theory of OT that divides constraints into markedness and faithfulness (as we have seen) does not predict counterbleeding and counterfeeding process interaction. This is because those involve overapplication and underapplication, respectively. Over- and under-

application are non-optimal solutions. Overapplication is problematic because OT always posits the *minimal* repair necessary to solve a phonotactic problem. Underapplication is problematic because if phonotactic problems are repaired then they should always be repaired.

★ Can you think of ways to fix the OT analyses above?

2.5 Saltatory alternations

The intuition here is that a saltatory alternation is one kind of "over-fixing" of a phonotactic problem—the repair is less faithful than it need be to solve the problem. In this way it is like the 'extrvagant repair' in counterbleeding cases. It is different because there are not necessarily two interacting processes. A saltatory alternation may be a simple alternation.

As far as I know, Bruce Hayes is the only person who uses the term "saltation", but I think it is a good choice.[1]

Here is an example of a saltatory alternation from Campidanian Sardinian[2] In this language there is intervocalic lenition of voiceless stops /p, t, k/ and the voiceless affricate /t͡ʃ/ (underlying forms justified by appearance in isolation):

/bɛlːu **p**iʃːi/	→	[bɛlːu **β**iʃːi]	'nice fish'
/sːu **t**rintaduzu/	→	[sːu **ð**rintaduzu]	'the thirty-two'
/dɛ **k**uatːru/	→	[dɛ **ɣ**uatːru]	'of four...'
/sːu **t͡ʃ**ɛlu/	→	[sːu **ʒ**ɛlu]	'the heaven'

However underlying intervocalic /b, d, g/ are preserved in this environment.

/sːa **b**ia/	→	[sːa **b**ia]	'the road'
/sːu **g**atːu/	→	[sːu **g**atːu]	'the cat'
/donːia **d**ominiɣu/	→	[donːja **d**ominiɣu]	'every Sunday'

These are optionally deleted, but only in certain words; we'll return to this point later.

[1] OED "saltate": to leap, to jump, to skip

[2] Bolognesi, Roberto (1998) The Phonology of Campidaniana Sardinian, Holland Institute of Linguistics.

Bolognesi, p. 36, writes "Speakers not only do not spirantize voiced stops, but judge this ... as entirely ungrammatical, instead. For them a phrase such as, for example, *sːa βɔtːa* could only be the output of underlying *sːa pɔrta* ('the door'), and never of *sːa bɔrta* ('the time'). They claim the second interpretation to be wrong."

Also observe that The Campidanian saltatory alternation is productive as evidenced by loanwords.

sːa [p]olonia	→	sːa [β]olonia	'(the) Poland'
sːu [k]omputːɛ	→	sːu [ɣ]omputːɛ	'the computer'
sːu [t]asːi	→	sːu [ð]asːi	'the taxi'

There are other examples of saltation in the literature.

1. /g/ → [x] finally, but final /k/ remains [k]. (Colloquial Northern German; Ito and Mester 1999)[3]

2. L tone in Suma become H in a context where M remains (Bradshaw 1999)[4]

Saltations were not thought of as a problem in the rule era, since rules can easily express saltation.

★ Express the saltatory rule for Campidanian.

They are an outstanding problem for OT, which posits minimal repair of all phonotactic violations.

★ Work out a grammar in which /apa/ surfaces as [aβa]. (What features change?) Submit /aba/ to this grammar.

[3]Ito and Mester. 1999. On the sources of Opacity in OT: coda processes in German. Caroline Féry and Ruben van de Vijver (eds.), The syllable in Optimality Theory, Cambridge University Press. (Also ROA).

[4]Tone Alternations in the Associative Construction of Suma. Proceedings of the 26th Annual Conference on African Linguistics, 1998.

3 Responses to opacity in OT

There are two types of responses:

1. Question the data
2. Change the theory

3.1 Trimming away suspected cases of opacity

One response has been to become more skeptical of opacity as correctly described, genuine phonological phenomenon. This has been pursued

1. Cases where non-neutralization or near-neutralization implies that the output is not opaque.
2. Cases where the phonology involved is not productive.

How are sure are we have an opaque interaction between processes?

3.2 Near-neutralization

If what Polish has is not

$$/\text{b,d,g}/ \rightarrow [\text{p,t,k}] \; / \; \underline{\quad} \;]_{word}$$

but

$$/\text{b,d,g}/ \rightarrow [\text{b̥,d̥,g̊}] \; \underline{\quad} \;]_{word}$$

then [b̥,d̥,g̊] can be included in the triggers for Raising, and the process is not opaque (Slowiaczek and Dinnsen, 1985).

As far as I know, most claimed phonological neutralizations have not been checked to see if they are really near-neutralizations.

3.3 Lack of productivity

The Polish example has been empirically attacked by Nathan Sanders[5] as suffering from exceptions and lack of productivity. He says "I am only concerned here with the [o]∼[u] alternation in masculine nominative nouns. The same alternation exists in the feminine and neuter genitive, in which the plural is opaque. I have been informed that the genitive alternation is fully productive (Anna Lubowicz and Jerzy Rubach, p.c.), though I have not yet verified this claim through experimentation."

[5] "Preserving synchronic parallelism: Diachrony and opacity in Polish", Chicago Linguistic Society 37

His two speakers do not extend the alternation in a "generative" (as opposed to "choice") Wug-test.

The general point is that if we are developing a theory of the internaized grammar of the speaker, and not of the patterns in a dictionary, we may want to check on the productivity of opacity cases before analyzing the speaker that way.

3.4 Changing OT

There are many approaches that have been tried in OT.

- Sympathy (John McCarthy)
- Comparative markedness (John McCarthy)
- Candidate chains (John McCarthy)
- Harmonic Serialism (John McCarthy)
- Targeted constraints (Colin Wilson)
- Constraint conjunction (Paul Smolensky, Robert Kirchner, Ania Lubowicz, and others)
- Output-output correspondence (Katherine Crosswhite, Laura Benua, and others)
- Two level constraints/turbid representations (Paul Smolensky, Matt Goldrick, Orhan Orgun, Diana Archangeli, Keiichiro Suzuki, and others)
- Allomorph listing (Nathan Sanders)

Clearly this is not settled! (Note also some of these only address some of the derivational residue, not all of it.) These approaches tend to fall into two classes:

- enriching faithfulness
- introducing derivations into OT

The major approaches, in my opinion are:

- Constraint conjunction
- Output-to-Output Correspondence
- Stratal OT

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