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# Week 10 – Opacity in OT I

April 21 and 23, 2008

## 1 The Derivational Residue

- (1) Classical derivational phonology treated **alternation** as the fundamental problem of phonology, and leaves the problem of well-formedness to the background.
- (2) OT treats **well-formedness** as the fundamental problem of phonology, and leaves the problem of alternation to the background.
- (3) Does this perhaps leave behind a “derivational residue” of cases that don’t smoothly emerge from the rankings of markedness and faithfulness?

### 1.1 Residue

- (4) Following Bruce Hayes, I think there are basically three.

a. Extravagant repair (counterbleeding)

$/\text{.}\text{a}\text{i}\text{t}\text{ə}/ \rightarrow [\text{.}\text{a}\text{i}\text{r}\text{ə}]$ , where  $[\text{.}\text{a}\text{i}\text{r}\text{ə}]$  would avoid  $*\text{a}\text{i}[-\text{voice}]$

b. Counterfeeding chains

$/\text{n}\#/ \rightarrow [\#\]$ , but  $/\text{nt}\#/ \rightarrow [\text{n}\#]$  in Catalan

c. Saltation

$/\text{p}/ \rightarrow [\beta]$ , where  $[\text{b}]$  would be fine.

### 1.2 Transparent Rule orderings in OT

#### 1.2.1 Rule A “feeds” Rule B

- (5) That is, Rule A applies first and creates the environment that allows Rule B to apply.
- (6) Example: Catalan

		$/\text{bint pans}/$
A: Deletion	$[-\text{cont}] \rightarrow \emptyset / [+nas] \text{ \_\_\_\_\_\_ } ]_{\sigma}$	bin pans
B: Place assimilation	$[+nas] \rightarrow [\alpha \text{ place}] / \text{ \_\_\_\_\_\_ } \left[ \begin{array}{l} +\text{cons} \\ \alpha\text{place} \end{array} \right]$	bim pans

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

(7) Feeding is easy in OT. If the markedness constraints driving the two changes are both high-ranked, then they both have to be satisfied, so both changes apply:

	/bint pans/	*[+nas][-cont] ] <sub>σ</sub>	*	<i>+nas</i> <i>αplace</i>	<i>+cons</i> <i>-αplace</i>	MAX-C	IDENT (PLACE)
bad because of nt] <sub>σ</sub>	bint pans						
deleting [t] causes a new problem, [np]	bin pans						
both changes apply, fixing both problems	↔ bim pans						

1.2.2 Rule A “bleeds” Rule B

(8) That is, Rule A applies first and takes away the environment that would have allowed Rule B to apply.

A: Epenthesis	[∅] → I / [+sibilant] _____ [+sibilant]#	/brænt <sup>h</sup> f+z/
B: Voice assimilation	[+son] → [α voice] / $\left[ \begin{array}{c} -son \\ \alpha voice \end{array} \right]$ _____	brænt <sup>h</sup> fz

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

(9) 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:

	/bræntʃ+z/	*[+sib][+sib]#	*	-son avoiced	-son -avoiced	DEP-V	IDENT (VOICE)
doubly bad because of $\widehat{t/z}$	bræntʃz						
devoicing solves only one problem	bræntʃs						
epenthesis solves both problems	↵ bræntʃɪz						
gratuitous voicing change	bræntʃɪs						

### 1.3 Counterbleeding

(10) Rule A fails to bleed Rule B because B applies first (“A counterbleeds B”)

(11) Malagasy

		/batah/
B: Final C neutralization	$h \rightarrow k / \_\_\_\#$	batak
A: Epenthesis	$\emptyset \rightarrow a / C \_\_\_\#$	bataka

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

(12) Catalan

		/bɛŋk/
B: Place assimilation	$[+nas] \rightarrow [αplace] / \_\_\_\left[ \begin{array}{l} +cons \\ αplace \end{array} \right]$	bɛŋk
A: Deletion	$[-cont] \rightarrow \emptyset / [+nas] \_\_\_\ ]_σ$	bɛŋ

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

(13) Counterbleeding is hard to do in OT—we get the wrong winner, because if one change (deletion) can solve both problems, the other change (assimilation) has no reason to apply:

	/bEnk/	*[+nas][-cont] ] <sub>σ</sub>	* [ +nas αplace ]	[ +cons -αplace ]	MAX-C	IDENT (PLACE)
doubly bad b/c of nk] <sub>σ</sub>	bɛnk	*(!)	*(!)			
assimilation fixes only one prob- lem	bɛŋk	*!				*
deletion fixes both problems	☞ bɛn				*	
apparently gratuitous [p]lace change	♠ bɛŋ				*	*!

(14) Hence counterbleeding is a process which appears to have a *extravagant repair*.

## 1.4 Counterfeeding

(15) Rule A fails to feed Rule B because B applies first. (In that case, we can say “A counterfeeds B”.)

(16) Catalan has alternations like:

- [kətəlan-ə] [kətəla] ‘Catalan, f., m.’
- [bint-ɛ] ‘20th’ [bin] ‘20’
- There appears to be word-final [n] and [t] deletion.

★ What must the ordering of [n] and [t] deletion be in Catalan?

(17) Here’s a classic one: Bedouin Arabic

- [a] normally raises to [i] in open syllables: /katab/ → [ki.tab]
- But...

<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-bottom: 1px solid black; padding: 2px;">B: Raising in open syllables</td> <td style="border-bottom: 1px solid black; padding: 2px;">a → i / <u>    </u> ]<sub>σ</sub></td> <td style="border-bottom: 1px solid black; padding: 2px;">/gabr/</td> </tr> <tr> <td style="padding: 2px;">A: Epenthesis in complex codas</td> <td style="padding: 2px;">[∅ → u / C <u>    </u> C]<sub>σ</sub></td> <td style="padding: 2px;">gabur</td> </tr> </table>	B: Raising in open syllables	a → i / <u>    </u> ] <sub>σ</sub>	/gabr/	A: Epenthesis in complex codas	[∅ → u / C <u>    </u> C] <sub>σ</sub>	gabur	
B: Raising in open syllables	a → i / <u>    </u> ] <sub>σ</sub>	/gabr/					
A: Epenthesis in complex codas	[∅ → u / C <u>    </u> C] <sub>σ</sub>	gabur					

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

- ★ To get /katab/ → [ki.tab], what's the ranking of  $*a]_{\sigma}$  vs. IDENT(hi), IDENT(lo)?

/katab/	
☞ ka.tab	
ki.tab	

- (18) Counterfeeding is also hard to do in OT. If making one change (epenthesis) creates a problem ( $a]_{\sigma}$ ) that is normally not tolerated, that problem should get solved by making another change (raising):

	/gabr/	$*a]_{\sigma}$	*COMPLEX CODA	DEP-V	IDENT(hi)	IDENT(lo)
bad b/c of $br]_{\sigma}$	gabr					
epenthesis fixes one problem but creates a new one	♠ ga.bur					
raising fixes the new problem	☞ gi.bur					

- ★ Why can't we just rank  $*a]_{\sigma}$  lower?

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

## 1.5 Saltatory alternations

- (20) 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.

(21) A *gradually divergent phonetic path* such as  $(X_1, X_2, X_3, \dots X_n)$  is a gradually divergent phonetic path for  $X_1, X_2$  iff for each  $(X_{i-1}, X_i)$  pair,  $X_{i-1}$  and  $X_i$  differ by just one feature change, segment insertion, or segment deletion. In other words, paths are connected by a minimal change.

a. For more on “gradual divergence”, see McCarthy (forthcoming)<sup>1</sup>

b. Examples of gradually divergent phonetic paths:

(g, k, x) (changes [voice], then [continuant])

(g, ʁ, x) (changes [continuant], then [voice])

(22) A representation P is *phonologically legal* if the output of some phonological grammar applied to /P/ is [P].

(23) A *Saltatory Alternation* is an alternation that leaps across a phonologically legal point on a gradually divergent phonetic path to another phonologically legal point.

(24) As far as I know, Bruce Hayes is the only person who uses the term “saltation”, but the alternative is much less explicit.<sup>2</sup>

(25) An example of a saltatory alternation: Campidanian Sardinian

a. Source: Bolognesi, Roberto (1998) *The Phonology of Campidanian Sardinian*, Holland Institute of Linguistics

(26) Intervocalic lenition of voiceless stops /p, t, k/ and the voiceless affricate /tʃ/ (underlying forms justified by appearance in isolation):

bɛ:u [p]iʃi	→	bɛ:u [β]iʃi	‘nice fish’
s:u [t]rintaduzu	→	s:u [ð]rintaduzu	‘the thirty-two’
dɛ [k]uat:ru	→	dɛ [ç]uat:ru	‘of four...’
s:u [tʃ]ɛlu	→	s:u [ʒ]ɛlu	‘the heaven’

(27) Preservation of underlying intervocalic /b, d, g/:

s:a [b]ia	→	s:a [b]ia	‘the road’
s:u [g]at:ru	→	s:u [g]at:ru	‘the cat’
don:ia [d]ominiyu	→	don:ja [d]ominiyu	‘every Sunday’

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

(28) Bolognesi, p. 36, “Speakers not only do not spirantize voiced stops, but judge this ... as entirely ungrammatical, instead. For them a phrase such as, for example, s:a βɔt:a could only be the output of underlying s:a pɔrta (‘the door’), and never of s:a bɔrta (‘the time’). They claim the second interpretation to be wrong.”

(29) The Campidanian saltatory alternation is productive:

<sup>1</sup>The paper is here: <http://people.umass.edu/jjmccart/metrically-conditioned-syncope.pdf>.

<sup>2</sup>OED “saltate”: to leap, to jump, to skip

s:a [p]olonia	→	s:a [β]olonia	‘(the) Poland’
s:u [k]omput:ɛ	→	s:u [ɣ]omput:ɛ	‘the computer’
s:u [t]asi	→	s:u [ð]asi	‘the taxi’

(30) Other examples of saltation

- a. /g/ → [x] finally, but final /k/ remains [k]. (Colloquial Northern German; Ito and Mester 1999)<sup>3</sup>
- b. L tone in Suma become H in a context where M remains (Bradshaw 1999)<sup>4</sup>
- c. Standard German: final stressless /ɪg/ vaults over /ɪk/ to land at [ɪx]<sup>5</sup>.
  - (i) *kräftig* [ˈkʁɛftɪx] ‘strong’    *kräftige* [ˈkʁɛftɪgə] ‘strong-fem./pl/etc.’
  - (ii) *zierlich* [ˈt͡si:ʁlɪx] ‘elegant’    [ˈt͡si:ʁlɪxə] ‘elegant-fem./pl/etc.’
  - (iii) [ˈplastɪk] ‘plastic’

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

★ Express the saltatory rule for Campidanian.

(32) 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.

## 2 Strategies to address the derivational residue in OT

(33) There are many approaches that have been tried in OT.

- Sympathy (John McCarthy)
- Comparative markedness (John McCarthy)
- Candidate chains (John McCarthy)
- Targeted constraints (Colin Wilson)

<sup>3</sup>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).

<sup>4</sup>Tone Alternations in the Associative Construction of Suma. Proceedings of the 26th Annual Conference on African Linguistics, 1998.

<sup>5</sup>Lubowicz, Anna. 1999. Derived environment effects in OT. The Proceedings of the Seventeenth West Coast Conference on Formal Linguistics, ed. by Kimary Shahin, Susan Blake and Eun Sook Kim, 451-65. Stanford, CA: Center Study Language & Information. [Rutgers Optimality Archive 239]

- 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)
- (34) Clearly this is not settled! (Note also some of these only address some of the derivational residue, not all of it.)
- (35) These approaches tend to fall into two classes:
- a. enriching faithfulness
  - b. introducing derivations into OT
- (36) I am going to try to review what I consider to be major approaches, in particular:
- Constraint conjunction
  - Output-to-Output Correspondence
  - Stratal OT
  - Candidate Chain Theory

## 2.1 Constraint Conjunction

- (37) *Constraint Conjunction* is one strategy people have used to handle saltation.
- a. Anna Lubowicz (1998) ‘Derived Environment Effects in OT’<sup>6</sup>
  - b. Ito, Junko and Armin Mester (1999)
- (38) Lubowicz’s answer, endorsed by Ito/Mester: constraints that are violated when two conditions are met in the same location (“local conjunction”). For C:
- $$*\text{IDENT}(\text{VOICE}) \text{ AND } *[-\text{cont}, +\text{dorsal}]/\text{r}\_\_\_\_\_\_ ]_{\text{word}}$$
- (39) Intuition: “Don’t have a intervocalic stop if you’re also changing voice” Fill in constraints and reassure yourself that this gets you what is needed:

	/apa/	Id(vce) & *V[-cont]V	*V[-vce]V	ID(voice)	*β	ID(cont)	*V[-cont]V
a.	↵ aβa						
b.	apa						
c.	aba						

<sup>6</sup>Lubowicz, Anna. 1999. Derived environment effects in OT. The Proceedings of the Seventeenth West Coast Conference on Formal Linguistics, ed. by Kimary Shahin, Susan Blake and Eun Sook Kim, 451-65. Stanford, CA: Center Study Language & Information. [Rutgers Optimality Archive 239]

	/aba/	Id(vce) & *V[-cont]V	*V[-vce]V	ID(voice)	*β	ID(cont)	*V[-cont]V
a.	aba						
b.	apa						
c.	↵ aβa						

	/βa/	Id(vce) & *V[-cont]V	*V[-vce]V	ID(voice)	*β	ID(cont)	*V[-cont]V
a.	↵ ba						
b.	βa						
c.	pa						

(40) Conjunction has to be local to avoid insane results like: /tɪk/ → [tɪk], /pag-tɪk/ → [paktɪx] (the assimilatory voicing of the first /g/ permits the second /k/ to spirantize).

(41) We may wish for Campidanian to specify the locus for locality:

$$*[-cont] / V \_\_\_\_ V$$

(42) We'll see later that it's hard to be completely local.

(43) As constraint families grow, the constraints grow... If there are  $m$  possible Markedness constraints and  $n$  Faithfulness constraints, there are now  $m \times n$  constraints...

(44) Factorial Typology

- Form of the constraint: “don't be both marked and unfaithful”
- Lubowicz's intent: “if you're unfaithful, don't be marked”
- An additional consequence: “if you're marked, be faithful”—meaning we can get special entities arise only in a marked context, which is going to be a problem

(45) An Apparent Disaster Case

	/ba/	Id(voice) & *CCC	MAX(C)	*[-son, +voice]	*CCC	Id(voice)
	↵ pa					
	ba					

	/aptka/	Id(voice) & *CCC	MAX(C)	*[-son, +voice]	*CCC	Id(voice)
	↵ aptka					
	apka					

	/apdka/	Id(voice) & *CCC	MAX(C)	*[-son, +voice]	*CCC	Id(voice)
	↵ apdka					
	aptka					

- (46) What is wrong?
- a. I think it is the “primitive” approach to Faithfulness in classical OT—just IDENT, MAX, DEP, and a few others.
  - b. We need to expand the power of the theory—in a way that doesn’t give it insanely excessive power.
  - c. Some potentially relevant ideas:
    - (i) Steriade’s view that unfaithful mappings prefer to be phonetically minimal
    - (ii) The view that UG can impose bias, and not just absolute bans

## 2.2 Non-surface constraint environments

- (47) Ref. John McCarthy (1996) Remarks on phonological opacity in Optimality Theory. In Jacqueline Lecarme, Jean Lowenstamm, and Ur Shlonsky, eds., *Studies in Afroasiatic Grammar. Papers from the Second Conference on Afroasiatic Linguistics*, Sophia Antipolis, 1994. The Hague: Holland Academic Graphics. Pp. 215-243.
- (48) Recall Polish counterbleeding opacity:

	<i>sg.</i>	<i>pl.</i>	
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)	żwup	żwobi	‘crib’
l)	lut	lodi	‘ice’
m)	vus	vozi	‘cart’
n)	ruk	rogi	‘horn’

- (49) For Polish /voz/ → [vus]: “A nonlow back vowel must be high, if it is followed by a voiced obstruent at the level of underlying representation.”
- (50) This seems most straightforward but has not been widely favored, perhaps because it seems like a brute-force solution.