Why and how not to counterbleed

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Workshop on Phonological Voicing Variation
Meertens Instituut, Amsterdam
September 11, 2008

Kenstowicz & Kisseberth (1971, 1977)

- Bleeding orders between vowel epenthesis and voicing assimilation are amply attested.
  - E.g. we frequently find, as in English:

    /bʌs+z/ $\underset{\text{EPEN}}{\longrightarrow}$ |bʌs+əz| $\underset{\text{ASSIM}}{\longrightarrow}$ *–bled–* $\Longrightarrow$ [bʌsəz]

- Counterbleeding orders between vowel epenthesis and voicing assimilation are unattested.
  - E.g. we do not appear to find:

    /bʌs+z/ $\underset{\text{ASSIM}}{\longrightarrow}$ |bʌs+s| $\underset{\text{EPEN}}{\longrightarrow}$ |bʌs+əs| $\Longrightarrow$ *[bʌsəs]

Baković & Pająk (2008)

- We show that this typological fact follows from a combination of three independent hypotheses within Optimality Theory (Prince & Smolensky 1993/2004):
  - the perceptual basis of faithfulness (Steriade 1997)
  - stringency relations among constraints (de Lacy 2006)
  - the account of opacity (counterbleeding) (McCarthy 2007)

Epenthesis bleeds assimilation

- In many languages, epenthesis applies between near-identical consonants . . .

	a. English	b. Lithuanian	c. Polish
UR	/siːt+d/	/at+duotʲi/	/z+skɑwɔ̃/
EPEN	siːt+əd	atʲi+duotʲi	zɛ+skɑwɔ̃
ASSIM	*–bled–*	*–bled–*	*–bled–*
SR	[siːtəd]	[atʲiduotʲi]	[zɛskɑwɔ̃]
	‘seated’	‘give back’	‘w/ a rock’

Assimilation applies otherwise

- . . . and assimilation applies otherwise.

	a. English	b. Lithuanian	c. Polish
UR	/siːs+d/	/at+gautʲi/	/z+kfɑsɛm/
EPEN	*–n/a–*	*–n/a–*	*–n/a–*
ASSIM	siːs+t	ad+gautʲi	s+kfɑsɛm
SR	[siːst]	[adgautʲi]	[skfɑsɛm]
	‘ceased’	‘get back’	‘w/ acid’

Baković (2005, 2007); Pająk (2007, 2008)

- Constraints:
  - NoGem (‘no geminates’)
    - (In Polish: ‘no *non-vowel-adjacent* geminates’)
  - Agree(voi) (‘adjacent obstruents agree in voicing’)
    - (In English: ‘adjacent *tautosyllabic* obstruents . . .’)
  - Dep (‘no epenthesis’)
  - Ident(voi) (‘no voicing changes’)
- Rankings:
  - Agree(voi) $\gg$ Ident(voi) (assimilation to avoid disagreement)
  - NoGem $\gg$ Dep (epenthesis to avoid geminates)
  - Dep $\gg$ Ident(voi) (no epenthesis to avoid disagreement)
  - Agree(voi) $\gg$ Dep (no dissimilation to avoid geminates)

‘Classic’ OT analysis of assimilation

/z+kfɑsɛm/ ‘w/ acid’	NoGem	Agree(voi)	Dep	Ident(voi)	*comment*
a. zkfɑsɛm		* !			*faithful*
b. ☞ skfɑsɛm				*	*assimilation*
c. zɛkfɑsɛm			* !		*epenthesis*

‘Classic’ OT analysis of epenthesis

/z+skɑwɔ̃/ ‘w/ a rock’	NoGem	Agree(voi)	Dep	Ident(voi)	*comment*
a. zskɑwɔ̃		* !			*faithful*
b. sskɑwɔ̃	* !			*	*assimilation*
c. ☞ zɛskɑwɔ̃			*		*epenthesis*

Counterbleeding opacity

- **Counterbleeding**$_{def}$: a process $\mathcal{R}$ applies after another process $\mathcal{P}$, obscuring the reason for $\mathcal{P}$'s application.
  - Suppose $\mathcal{P}$ = ASSIM and $\mathcal{R}$ = EPEN.
  - Given e.g. /bʌs+z/, ASSIM applies first to give |bʌs+s|.
  - EPEN then applies to give |bʌs+əs|.
  - The reason for ASSIM's application (adjacent obstruents disagreeing in [±voice]) has thus been obscured by EPEN.

Attested vs. unattested orders

- According to Kiparsky's (1971, 1973) *opacity hypothesis*, examples of counterbleeding are, at worst, hard to learn.
- But the counterbleeding order ASSIM $>$ EPEN is unattested.
- Kiparsky's hypothesis makes no formal distinction between these unattested cases and other, relatively common cases of counterbleeding: both should be attested.
- 'Classic' OT also makes no formal distinction between the two kinds of cases: both should be *un*attested.

‘Classic’ OT: counterbleeding unattested

/z+skɑwɔ̃/	NoGem	Agree(voi)	Dep	Ident(voi)	*comment*
a. zskɑwɔ̃		* !			*faithful*
b. sskɑwɔ̃	* !			*	*assimilation*
c. ☞ zɛskɑwɔ̃			*		EPEN *bleeds* ASSIM
d. sɛskɑwɔ̃			*	* !	EPEN *counterbleeds* ASSIM

This additional faithfulness violation is *gratuitous*.

‘Classic’ OT: counterbleeding unattested

/z+skɑwɔ̃/	NoGem	Agree(voi)	Dep	Ident(voi)	*comment*
a. zskɑwɔ̃		* !			*faithful*
b. sskɑwɔ̃	* !			*	*assimilation*
c. ☞ zɛskɑwɔ̃			*		EPEN *bleeds* ASSIM
d. ~~sɛskɑwɔ̃~~			*		~~EPEN *counterbleeds* assim~~

Bleeding candidates *harmonically bound* counterbleeding candidates, rendering the latter incapable of ever winning.

Deletion counterbleeds assimilation

- One common type of counterbleeding is ASSIM $>$ DEL.
  - E.g., Austronesian nasal substitution (Pater 1999):
    /məŋ+pilih/ $\underset{\text{ASSIM}}{\longrightarrow}$ |məm+pilih| $\underset{\text{DEL}}{\longrightarrow}$ |məm+ilih| $\Longrightarrow$ [məmilih]
  - E.g. Bedouin Arabic velar palatalization (McCarthy 2007):
    /ħakim+in/ $\underset{\text{PAL}}{\longrightarrow}$ |ħakʲim+in| $\underset{\text{DEL}}{\longrightarrow}$ |ħakʲm+in| $\Longrightarrow$ [ħakʲmin]
- What (formally) distinguishes the attested ASSIM $>$ DEL order from the unattested ASSIM $>$ EPEN order?

Steriade (1997)

- Voicing disagreement is only ever resolved by assimilation, never by epenthesis or deletion (see also Lombardi 2001).
- Less perceptible repairs of marked sequences are preferable to more perceptible repairs:
  - Voicing contrasts are difficult to perceive in e.g. English VC<u>C</u>#, Lithuanian V<u>C</u>CV, Polish #<u>C</u>CCV, etc.
  - *Hypothesis:* assimilation in these positions is the least perceptible possible change to avoid voicing disagreement.

Constraint interaction

- If these are independent and independently rankable constraints in 'classic' OT . . .
  - DEP ('no epenthesis')
  - MAX ('no deletion')
  - IDENT(voi) ('no voicing changes')
- . . . then the lowest-ranked of the three will determine the preferred resolution of voicing disagreement:
  - {DEP, MAX} $\gg$ IDENT(voi) — assimilation
  - {DEP, IDENT(voi)} $\gg$ MAX — deletion
  - {MAX, IDENT(voi)} $\gg$ DEP — epenthesis

Universal ranking or stringency

- Two ways to guarantee the preference for assimilation are:
  - to rank these faithfulness constraints universally, much as Steriade (1997) proposes: {DEP, MAX} $\gg$ IDENT(voi), or
  - to state these constraints such that they are in a *stringency relation*, as in de Lacy (2006): *FAITH-1 $\Rightarrow$ *FAITH-2.
    - FAITH-1 is violated by any change,
    - FAITH-2 is violated more by 'more perceptible' changes.
- Either way, the relative perceptibility of different changes is mirrored by the relative 'importance' of the faithfulness constraints violated by those changes.

McCarthy (2007)

- Key assumptions of OT with 'candidate chains' (OT-CC):
  - Candidates are chains: $\langle input_0, link_1, link_2, \ldots, output_n \rangle$.
  - $link_n$ = $link_{n-1}$ + one harmonically-improving change.
  - PREC(A, B): violated by candidate chains in which:
    - violations of a faithfulness constraint B are (i) followed by or (ii) not preceded by violations of a faithfulness constraint A.
  - B $\gg$ PREC(A, B) for all faithfulness constraints B.
- Counterbleeding results when PREC(A, B) $\gg$ A.

Counterbleeding in OT-CC: ASSIM > DEL

/məŋ+pilih/		NoNC°	Agree(pl)	Max	Prec(Id(pl), Max)	Ident(pl)
a.	⟨məŋpilih⟩		* !			
b.	⟨məŋpilih, məmpilih⟩	* !				*
c.	⟨məŋpilih, məŋilih⟩			*	* !	
d. ☞	⟨məŋpilih, məmpilih, məmilih⟩			*		*

Counterbleeding in OT-CC: ASSIM > EPEN

/z+skɑwɔ̃/ ‘w/ a rock’	NoGem	Agree(voi)	Dep	Prec(Id(v), Dep)	Ident(voi)
a. ⟨zskɑwɔ̃⟩		* !			
b. ⟨zskɑwɔ̃, sskɑwɔ̃⟩	* !				*
c. ☜ ⟨zskɑwɔ̃, zɛskɑwɔ̃⟩			*	* !	
d. ☞ ⟨zskɑwɔ̃, sskɑwɔ̃, sɛskɑwɔ̃⟩			*		*

- *Note:* Even if Dep ≫ Ident(voi) universally, this unattested counterbleeding interaction is possible under OT-CC.

- *Perceptibility hypothesis:*
  Assimilation is less perceptible than epenthesis.
- *Formal implementation:*
  Stringency between the relevant faithfulness constraints.
  - 1-FAITH — violated once by any change.
  - 2-FAITH — violated once for changes in voicing,
    twice for epenthesis, and
    thrice for both (in the 'same place').†
- More generally: the more perceptible a change, the more violations of faithfulness it incurs (specifically, of 2-FAITH).

†This notion requires clarification.

Blocking counterbleeding in OT-CC: ASSIM ≯ EPEN

/z+skɑwɔ̃/ ‘w/ a rock’	NoGem	Agree(voi)	2-Faith	Prec(1-F, 2-F)	1-Faith
a. ⟨zskɑwɔ̃⟩		* !			
b. ⟨zskɑwɔ̃, sskɑwɔ̃⟩	* !		*		*
c. ☞ ⟨zskɑwɔ̃, zɛskɑwɔ̃⟩			**	*	*
d. ⟨zskɑwɔ̃, sskɑwɔ̃, sɛskɑwɔ̃⟩			*** !		*

- 2-Faith universally blocks the potential of Prec(1-F, 2-F) to select the counterbleeding candidate (d).

Still allowing attested ASSIM > DEL orders

/məŋ+pilih/	NoNC°	Agree(pl)	2-Faith	Prec(1-F, 2-F)	1-Faith
a. ⟨məŋpilih⟩		* !			
b. ⟨məŋpilih, məmpilih⟩	* !		*		*
c. ⟨məŋpilih, məŋilih⟩			**	* !	*
d. ☞ ⟨məŋpilih, məmpilih, məmilih⟩			**		*

- ASSIM>DEL (d) is, if anything, *less* perceptible than DEL (c).

Previous proposals

- Kenstowicz & Kisseberth (1971) entertain the following hypothesis for the unattestedness of ASSIM $>$ EPEN:
  - EPEN 'affect[s] syllable structure'.
  - ASSIM 'crucially refer[s] to syllable structure'.
  - Rules that affect syllable structure precede rules that crucially refer to syllable structure.

  $\therefore$ EPEN $>$ ASSIM.
- Pinker & Prince (1988: 106) suggest that this ordering follows from phonology (EPEN) preceding phonetics (ASSIM).

Previous proposals

- Kenstowicz & Kisseberth (1971: 10) immediately reject this hypothesis on the basis of attested ASSIM $>$ DEL orders.
  - DEL 'affect[s] syllable structure' like EPEN does.
- Concerning the 'typical' order PAL $>$ DEL, K&K note:
  - 'Perhaps one might suggest that the non-bleeding order is preferred because the i which drops by apocope leaves a "trace" on the preceding consonant.'
- Counterbleeding here serves a kind of function: PAL makes the item affected by DEL recoverable.
  - See also Kaye (1974, 1975) and more recently Łubowicz (2003).

Previous proposals

- Kenstowicz & Kisseberth (1977: 172*ff*) build on this functionally-motivated recoverability hypothesis:
  - *Phonological rules will not (normally) interact in a fashion that creates phonetic opacity unless motivated to do so.*
- What 'motivates' opacity?
  - Reduction of allomorphy within paradigms
    - = Kiparsky's (1971, 1973) reanalysis of Kiparsky (1968)

Previous proposals

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  - *Phonological rules will not (normally) interact in a fashion that creates phonetic opacity unless motivated to do so.*
- What 'motivates' opacity?
  - 'the nature of the phonological rules themselves'
    - = mutual bleeding in e.g. Nootka

Previous proposals

- Kenstowicz & Kisseberth (1977: 172*ff*) build on this functionally-motivated recoverability hypothesis:
  - *Phonological rules will not (normally) interact in a fashion that creates phonetic opacity unless motivated to do so.*
- What 'motivates' opacity?
  - 'serving to preserve underlying semantic contrasts'
    - = the result of ASSIM $>$ DEL orders
- Regarding the unattestedness of ASSIM $>$ EPEN:
  - '[T]he opacity [of ASSIM $>$ EPEN] would not be offset by any gain in semantic transparency.' (K&K 1977: 173)

Distinguishing the proposals

- Closed syllable shortening (CSS) and EPEN are able to interact both transparently (a) and opaquely (b).

	a. Yokuts	b. Arabic	
UR	/ʔaːml+hin/	/ʃaːf+t/	UR
EPEN	ʔaːmil+hin	ʃaf+t	CSS
CSS	*–bled–*	ʃaf+it	EPEN
		ʃif+it	a → i / _ σ
SR	[ʔaːmilhin]	[ʃifit]	SR
	‘might help’	‘I saw’	

Bleeding in Yokuts: EPEN > CSS

/ʔaːml+hin/	NO[$\mu\mu\mu$]$_\sigma$	NOCOMPLEX	DEP	MAX(μ)	PREC(MX(μ), DP)
a. ⟨ʔaːmlhin⟩	* !	* !			
b. ⟨ʔaːmlhin, ʔamlhin⟩	(* !)	* !		*	
c. ☞ ⟨ʔaːmlhin, ʔaːmilhin⟩			*		*
d. ⟨ʔaːmlhin, ʔamlhin, ʔamilhin⟩			*	* !	

Counterbleeding in Arabic: CSS > EPEN

/ʃaːf+t/		NO[$\mu\mu\mu$]$_\sigma$	NOCOMPLEX	DEP	PREC(MX(μ), DP)	MAX(μ)
a.	⟨ʃaːft⟩	* !	* !			
b.	⟨ʃaːft, ʃaft⟩	(* !)	* !			*
c.	⟨ʃaːft, ʃaːfit⟩			*	* !	
d. ☞	⟨ʃaːft, ʃaft, ʃafit⟩			*		*

- Counterbleeding in this case is not obviously 'offset by [a] gain in semantic transparency', at least not any more than ASSIM>EPEN.

- (|ʃafit| ⟶ [ʃifit] by nonfinal open syllable raising.)

Counterbleeding in Arabic: CSS > EPEN

/ʃaːf+t/		NO[$\mu\mu\mu$]$_\sigma$	NOCOMPLEX	DEP	PREC(MX(μ), DP)	MAX(μ)
a.	⟨ʃaːft⟩	* !	* !			
b.	⟨ʃaːft, ʃaft⟩	(* !)	* !			*
c.	⟨ʃaːft, ʃaːfit⟩			*	* !	
d. ☞	⟨ʃaːft, ʃaft, ʃafit⟩			*		*

- In our proposal, CSS>EPEN must not be a more perceptible change, in the relevant sense, than EPEN alone.

- (|ʃafit| ⟶ [ʃifit] by nonfinal open syllable raising.)

Counterbleeding in Arabic: CSS > EPEN

/ʃaːf+t/		NO[$\mu\mu\mu$]$_\sigma$	NOCOMPLEX	DEP	PREC(MX(μ), DP)	MAX(μ)
a.	⟨ʃaːft⟩	* !	* !			
b.	⟨ʃaːft, ʃaft⟩	(* !)	* !			*
c.	⟨ʃaːft, ʃaːfit⟩			*	* !	
d. ☞	⟨ʃaːft, ʃaft, ʃafit⟩			*		*

- Changes must be *adjacent* to be compared for perceptibility?
- Or: EPEN and CSS 'cancel each other out' in their effect on mora count?

- (|ʃafit| ⟶ [ʃifit] by nonfinal open syllable raising.)

New Julfa Armenian

- Odden (2005) juxtaposes bleeding in Lithuanian (a) with counterbleeding in New Julfa Armenian (b).

	a. Lithuanian	b. Armenian	
UR	/at+duotʲi/	/k+zəram/	UR
EPEN	atʲi+duotʲi	g+zəram	ASSIM
ASSIM	*–bled–*	gə+zəram	EPEN
SR	[atʲiduotʲi]	[gəzəram]	SR
	‘give back’	‘I will bray’	

New Julfa Armenian

- According to Vaux (1998: 216; *emphasis* added):
  - ‘since intervening -ə- but not full vowels are transparent to [ASSIM], *we can say* that the rule applies before [EPEN], *which produces all schwas* in the New Julfa dialect’
  - The facts are thus consistent with *transparency* of schwa.
- *cf.* Urban Utrecht Dutch (van Oostendorp 2002, p.c.):

Faithfulness before sonorants

[də] *maker*	‘the maker’	[tə] *maken*	‘to make’

Voicing assimilation before obstruents

[də] *bakker*	‘the baker’	[də] *bakken*	‘to bake’
[tə] *pastoor*	‘the priest’	[tə] *pakken*	‘to take’

Future directions

- Defining and measuring perceptibility.
  - What details of perceptibility are expressed in faithfulness?
  - What types of changes can be compared for perceptibility?
- Collecting and categorizing cases of counterbleeding.
  - What cases are genuine vs. only apparent?
  - Are there multiple sources of opacity?
- Comparing other approaches to opacity.
  - Targeted constraints? ((Baković &) Wilson 2000, *et seqq.*)
  - Stratal OT? (Kiparsky to appear, Bermúdez-Otero to appear)

Thank you.

Comments, questions:

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