

# ***The too-many-solutions problem in OT; solutions on the market***

*EGG Summer School, Brno 2007, 29th of July - 10th of August*

Ben Hermans; Meertens Institute

ben.hermans@meertens.knaw.nl

## ***First approach: Fixed Ranking***

### *Goal of this meeting*

We will discuss one approach to the Too-many-solutions problem: *Fixed ranking*.

### *Steps in the presentation*

- Introduction of HTHP, one of the central premises of Optimality Theory;
- One example of Factorial Typology;
- Several examples of Conspiracies;
- The first instance of the Too-many-solutions problem; blocking in nasal harmony;
- Fixed ranking.

### *Homogeneity of Target, Heterogeneity of Process*

One of the key concepts in Optimality Theory holds that a given target can be repaired in different ways. This is called *Homogeneity of Target, Heterogeneity of Process*. This concept lies at the hearth of OT. From the crosslinguistic perspective it gives us *Factorial Typology*. From the perspective of individual languages it explains *Conspiracies*.

- *Factorial typology*; when two or more phenomena have a unitary result in different languages.
- *Conspiracies*; When two or more phenomena have a unitary result within the same language;

### *Factorial Typology;*

*stress shift and vowel reduction are two different reactions to a single target; free permutation of the relevant constraints derives the typology.*

(1) *Stress shift in Kiriwina* (based on de Lacy 2002, 2004)

a) Stress the penult

[i.dó.ja]

‘it drifts’

[dum.da.bó.gi]

‘early dawn’

[i.mom.kó.li]

‘he tasted (it)’

b) ‘Stress falls on the antepenultimate syllable in one situation: when the penult contains a high vowel and the ultima contains [a]’ (de Lacy 2004:37).

[mí.gi.la]	‘the face’
[lá.mi.la]	‘outrigger log’
[kú.li.a]	‘cooking pot’
[la.ó.di.la]	‘jungle’
[la.sí.ku.la]	‘pull canoe’
[mé.gu.va]	‘white magic’
[pá.ku.la]	‘blame’
[lú.gu.ta]	‘yam type’

c) ‘In contrast, stress does not retract when the penult contains a non-high vowel ..., or when the ultima contains a high vowel...’ (p. 38).

[tom.to.mó.ta]	‘dumb’
[i.dó.ja]	‘it drifts’
[ka.wá.la]	‘canoe pole’
[bo.ná.ra]	‘shelf (in house)’

[i.gi.bu.lú.i]	‘he is angry at’
[i.vá.gi]	‘he did (it)’
[m.tu.m <sup>w</sup> á.tu]	‘shaggy’
[i.mom.kó.li]	‘he tasted (it)’
[dum.da.bó.gi]	‘early dawn’
[m.ló.pu]	‘cave’

*The target* (preliminary version):

\*NON-HD/HIGHSONORITY

a vowel of high sonority is not allowed in a dependent position.

Other constraints (informal versions);

1. ALIGNFT-R; Align Foot to the right;
2. TROCHEE; A foot is trochaic;
3. FTBINARITY; The minimal size of a foot is two moras;
4. IDENT; A vowel must preserve its identity.

In *Kiriwina* the foot is located at the right edge of a word. If, however, the final vowel is of high sonority (mid or low) the foot is shifted to the left. This happens in the examples in b). There is no stress shift if, after the shift, the dependent position would still have a vowel of high sonority. This explains why there is no stress shift in the first set of examples in c).

#### Outline of an analysis of *Kiriwina* stress

\*NON-HD/HIGHSONORITY » ALIGNFT-R

migila	NON-HD <sub>FT</sub> /HS	ALIGNFT-R
mi(gíla)	*!	
☞ (mígi)la		*

\*NON-HD/HIGHSONORITY » ALIGNFT-R

idoja	NON-HD <sub>FT</sub> /HS	ALIGNFT-R
☞ i(dó)ja	*	
(ído)ja	*	*!

IDENT » ALIGNFT-R

migila	IDENT	ALIGNFT-R
mi(gí)la	*!	
☞ (mí)gila		*

The ranking \*NON-HD/HIGHSONORITY, IDENT » ALIGNFT-R derives a system where vowel quality is constant, and where the position of stress shifts in order to satisfy the constraint \*NON-HD/HIGHSONORITY.

(2) *Vowel reduction in Neapolitan Italian* (based on Harris 2005:4); other important works on reduction: Crosswhite (2001); Harris (1994, 1997)

vékə ‘he sees’	vəritə ‘see, IMP.PL’
ténə ‘he keeps’	tənitə ‘keep, IMP.PL’
kórrə ‘he runs’	kurrítə ‘run, IMP.PL’
pókə ‘a little’	pukurillə ‘a very little’

Ranking required for Neapolitan Italian:

\*NON-HD/HIGHSONORITY, ALIGNFT-R » IDENT.

korritə	*NON-HD/HS	ALIGNFT-R	IDENT
☞ kur(rítə)			*!
(kórri)tə		*	
kor(rítə)	*!		

*Conclusion:* Languages can react differently to \*NON-HD/HIGHSONORITY. In some languages stress shifts, such that the unstressed syllable has low sonority. In other languages the stress refuses to move, and then it can happen that the vowel quality changes. Both phenomena are reactions to the same marked structure (a high sonority vowel in unstressed position). These two systems fit in the typology that is expected, given free permutation of the constraints \*NON-HD/HIGHSONORITY, ALIGNFT-R, IDENT.

*Side remark*

Just like vowels in non-head position like to be of low sonority, vowels in head position like to be of high sonority. This can also trigger two effects: 1) stress shift (cf. de Lacy 2002, 2004 on Nganasan); 2) vowels can also change their identity (cf. Crosswhite 2001 on Zabiče Slovene; also Smith 2005).

*Conspiracy I; Axininca Campa* (based on McCarthy and Prince 1993b)

(3)

a) Hiatus is resolved by epenthesis

/i-N-koma-i/	iŋkomaTi	‘he will paddle’
/i-N-koma-aa-i/	iŋkomaTaaTi	‘he will paddle again’
/i-N-koma-ako-i/	iŋkomaTakoTi	‘he will paddle for’
/i-N-koma-ako-aa-i-ro/	iŋkomaTakoTaaTiro	‘he will paddle for it again’

b) /i-N-č <sup>h</sup> ik-i/	iñč <sup>h</sup> iki	‘he will cut’
/i-N-č <sup>h</sup> ik-aa-i/	iñč <sup>h</sup> ikaaTi	‘he will cut again’
/i-N-č <sup>h</sup> ik-ako-i/	iñč <sup>h</sup> ikakoTi	‘he will cut for’
/i-N-č <sup>h</sup> ik-ako-aa-i-ro/	iñč <sup>h</sup> ikakoTaaTiro	‘he will cut for it again’

The target:

ONSET

A syllable must have an Onset

Other constraints (informal version);

- DEP; Do not insert a segment

ONSET » DEP

i-N-koma-i	ONSET	DEP
☞ iŋkomati		*
iŋ.ko.ma.i	*!	

Why no diphthongization? This question is relevant, since the language allows diphthongs, like [ai].

(4)

c) /no-N-č <sup>h</sup> ik-wai-i/	noñč <sup>h</sup> ikAwaiTi	‘I will continue to cut’
/no-N-tasonɣk-wai-i/	nontasonɣkAwaiTi	‘I will continue to fan’

So, why doesn't /i-N-koma-i/ surface as \*[iŋkomai]?

The answer: Stem-alignment.

- ALIGN-STEM; A stem's right edge is aligned with the right edge of a syllable

ONSET, ALIGN-STEM » DEP

i-N-koma-i	ONSET	ALIGN-STEM	DEP
☞ iŋkoma ti			*
iŋ.ko.ma i	*!		
iŋ.ko.ma i.		*!	

A further question: why isn't there any epenthesis at the beginning of a word? Answer:

- ALIGN-STEM/WORD; A stem's left edge is aligned with the left edge of a prosodic word.

## ALIGN-STEM/WORD » ONSET

i-N-koma-i	ALIGN-ST/W	ONSET
☞ [iŋkomati		*
[tʲiŋ.ko.mati	*!	

*Conclusion:* A language can react in various ways to ONSET. Sometimes two adjacent vowels are grouped together into a diphthong; if that is not possible (as happens at the end of a stem) it epenthesizes a consonant. When that is not possible (at the beginning of a stem) nothing is done.

*A residual question:* if ALIGN-STEM enforces epenthesis of a consonant in cases where a stem ends in a vowel (the examples in a)), why isn't a vowel inserted in case a stem ends in a consonant (as in the examples in b))? Answer: NOCODA.

- NOCODA; A syllable may not have a coda

## NOCODA » ALIGN-STEM

i-N-č <sup>h</sup> ik-i	NOCODA	ALIGN-STEM	DEP
☞ iñ.č <sup>h</sup> i.k i.		*	
iñ.č <sup>h</sup> i.k ti	*!		
iñ.č <sup>h</sup> i.k a.ti		*	*!

*Conspiracy II; Guelavía Zapotec* (based on Gonzalez 2003 and Bye and de Lacy 2008)

(5)

a) Fortis consonants undergo gemination following the main-stressed nucleus

/rapa <sup>2</sup> /	[ráppa <sup>2</sup> ]	'I have'
/ʃpaka <sup>2</sup> /	[ʃpákka <sup>2</sup> ]	'my tadpole'
/naʃin/	[náʃʃin]	'it is sweet'

b) But before a lenis consonant it is the vowel that is lengthened (Bye and de Lacy 2008:13,14)

/rkwabede/	[rkwaβé:ðe]	'it is spicy'
/rago <sup>2</sup> /	[rá:yo <sup>2</sup> ]	'you bite'
/gózmi/	[gó:zmi]	'sickle'

*Conspiracy III; Latvian* (based on Bye and de Lacy 2008, p. 14)

(6)

a) 'Following short main-stressed nucleus, only obstruents undergo gemination...'

<likums>	[líkkums]	'law'
<desā>	[dǣssa:]	'in the sausage'
<miza>	[mízza]	'bark'

b) <ala>	[ála]	no gloss given
<zināt>	[zína:t]	'to know'
<pļava>	[płáva]	'meadow'

### *Conspiracy IV; Greek* (based on Pater 2003, p. 20)

(7)

a) In Modern Greek, post-nasal voicing applies;

/pemp+o/	[pembo]	‘I send’
/ton#topo/	[tondopo]	‘the place’

b) Except when the post-nasal obstruent is itself followed by a voiceless obstruent (a fricative). In this situation, nasal deletion applies instead, thus avoiding voicing disagreement between obstruents, which is generally prohibited in Greek (Pater 2003:20).

/e+pemp+s+a/	[epepsa]	‘I send, AOR.’
/ton#psefti/	[topsefti]	‘the liar’ (Cypriot)

### *Conspiracy V; Slavic* (based on Crist 2001)

At some point in the history of Common Slavic, closed syllables became disallowed. Closed syllables were eliminated via deletion, metathesis, and coalescence.

(8)

a) Deletion

PIE	OCS	
*supn-	sun-u	‘sleep’
*pled-men	plemē:	‘tribe’

b) Coalescence

*zomb-	zō:b-u	‘tooth’
*jimen	imē:	‘name’

c) Metathesis

*gard-	grad-u	‘city’
*melk-	mle:k-o	‘milk’

*Conclusion*; in many cases a single target (marked structure) is solved in various ways, both crosslinguistically and within a single language. This derives: 1) *a typology of languages* and 2) *conspiracies*.

### ***Now the problem***

In many languages the feature [+nasal] spreads across the word. However, certain consonants can block spreading. In Sundanese, all consonants block spreading, even glides. The following examples are from Walker (1999:2).

(9)

Nasal harmony in Sundanese

nãĩã	‘to wet’	mõlohok	‘to stare’
ñãjak	‘to sift’	jĩsər	‘to displace’
mãwur	‘to spread’	ñũdag	‘to pursue’
mãro	‘to halve’	ñãtur	‘to arrange’

Pater (2003) raises the following question. In principle, one can imagine that the quality of a blocker is changed, such that it allows spreading. Or one can imagine that the blocker is deleted, such that spreading is no longer inhibited.

- ❖ ‘Despite the considerable attention that the typology of nasal harmony has received in the phonological literature . . . , not a single case of this type has emerged. Similarly, other types of partial vowel harmony, such as ATR harmony and rounding harmony, never seem to dispose of blocking consonants or vowels through metathesis or deletion’ (p. 13).
- ❖ ‘. . . debuccalization is never used to render an opaque segment amenable to nasal spreading. Even though there are many languages in which glottal, but not oral stops, undergo nasalization, no language debuccalizes stops to permit spreading’ (p. 16).

*This is a typical instance of the too-many-solutions problem: of all the conceivable solutions to a specific problem, only a limited subset is actually attested. In the case of harmony: a blocking segment is not deleted, neither does it change its quality.*

Pater has the following two constraints: MAX-C and SPREAD(+NASAL). The former forbids deletion of a consonant, and the latter enforces spreading.

Now consider the following possibility:

SPREAD(+NASAL) » MAX-C

η̃atur	SPREAD(+NASAL)	MAX-C
η̃atur	**!*	
η̃aũr	*	*

Pater’s solution: **Fixed ranking!** MAX-C *always dominates* SPREAD(+NASAL). Also on fixed ranking: de Lacy (2003).

This is part of a general scheme:

**Generalized fixed ranking: SEGCOR » ASSIM**

The family of SEGCOR: MAX, DEP, LINEARITY, UNIFORMITY, INTEGRITY.

McCarthy and Prince (1995:370-372):

MAX

Every element of S<sub>1</sub> has a correspondent in S<sub>2</sub>.

DEP

Every element of S<sub>2</sub> has a correspondent in S<sub>1</sub>.

LINEARITY

S<sub>1</sub> is consistent with the precedence structure of S<sub>2</sub>, and vice versa.

UNIFORMITY

No element of S<sub>2</sub> has multiple correspondents in S<sub>1</sub>.

INTEGRITY

No element of S<sub>1</sub> has multiple correspondents in S<sub>2</sub>.

Pater (2003:15): ‘Crucially, IDENT constraints, which require that segments in correspondence have identical featural values, fall outside the scope of this denotation’.

This is obvious, because otherwise there couldn’t be any spreading process at all. Notice, though, that the second quotation above remains a puzzle. In other words, why isn’t it possible to eliminate a blocker *by changing its quality*.

### Fixed ranking; discussion

Fixed ranking seems a natural way to account for the too-many-solutions problem, the main reason being that it seems to be necessary anyway. One domain where fixed ranking seems necessary is the relation between stress shift phenomena and vowel quality (Kenstowicz 1997).

Foot non-head sonority constraints (Kenstowicz 1997)

\*NON-HD<sub>Ft</sub>/a » \*NON-HD<sub>Ft</sub>/e,o » \*NON-HD<sub>Ft</sub>/i,u » \*NON-HD<sub>Ft</sub>/ə » \*NON-HD<sub>Ft</sub>/i

De Lacy (2002, 2003) points out that fixed ranking cannot account for *conflation*. If classes are conflated, the sonority distinctions between their members do not count with respect to a certain process (like stress shift, for instance).

In *Kiriwina* there is conflation between mid and low vowels, cf. b) and c) on p. 2.

‘Fixed ranking prevents conflation of non-heads’ (de Lacy 2004, p. 44).

\*NON-HD<sub>Ft</sub>/a » \*NON-HD<sub>Ft</sub>/e,o » ALIGN<sub>Ft</sub>-R

Idoja	*NON-HD <sub>Ft</sub> /a	*NON-HD <sub>Ft</sub> /e,o	ALIGN <sub>Ft</sub> -R
🔔 (ído)ja		*	*
🔔 i(dó)ja	*!		

De Lacy's analysis (2004:41)

‘Conflation of low and mid vowels’ (p. 41):

\*NON-HD<sub>Ft</sub>/a,e<sup>o</sup> » ALIGN<sub>Ft</sub>-R

idoja	*NON-HD <sub>Ft</sub> /a,e <sup>o</sup>	ALIGN <sub>Ft</sub> -R
(ído)ja	*	*!
🔔 i(dó)ja	*	

\*NON-HD<sub>Ft</sub>/a is inactive’ (p. 41):

\*NON-HD<sub>Ft</sub>/a,e<sup>o</sup> » ALIGN<sub>Ft</sub>-R » \*NON-HD<sub>Ft</sub>/a

idoja	*NON-HD <sub>Ft</sub> /a,e <sup>o</sup>	ALIGN <sub>Ft</sub> -R	*NON-HD <sub>Ft</sub> /a
(ído)ja	*	*!	
🔔 i(dó)ja	*		*

De Lacy's theory in a nutshell: Head/non-head constraints refer to a continuous stretch on the sonority scale (not one single, isolated point). This allows *free ranking*, permutation, of these constraints. As a result of free ranking, certain problematic cases of conflation of sonority distinctions can be accounted for.

*Conclusion:* in the domain of stress theory fixed ranking is no longer a necessity. If fixed ranking is suspect in the domain of stress, then it is all the more so as a solution for the too-many-repair problem.

### Summarizing and further perspectives

Pater's paper contains a discussion of a kind of metathesis in Balantak. The phenomenon is very interesting. Here I will use it to:

- ✓ show once again that a single markedness constraint can have various effects in a single language;
- ✓ to raise questions about the legitimacy of metathesis. This might become important later in this class;
- ✓ to develop a representation of segments that might perhaps help us to explain instances of the too-many-solutions problem later in this class.

#### Balantak metathesis

a) If the root ends in a vowel or a glottal stop, then the empty position of the suffix is filled by the root's last vowel:

(10)

/tama+Vm/	[tamaam]	'your father'
/tambue+Vm/	[tambueem]	'your green beans'
/kopi+Vm/	[kopiim]	'your coffee'
/tigo+Vm/	[tigoom]	'your tobacco'
/apu+Vm/	[apuuum]	'your fire'
/aleʔ+Vm/	[aleʔem]	'your garden'
/bakokoʔ+Vm/	[bakokoʔom]	'your knife'
/oriiʔ+Vm/	[oriiʔ+im]	'your poles'

b) If the root ends in any consonant other than a glottal stop, then there seems to be a kind of metathesis; the suffixal consonant is deleted:

/sarat+Vm/	[saraat]	'your foot'
/popurun+Vm/	[popuruun]	'your sago'
/wewer+Vm/	[weweer]	'your lips'
/witis+Vm/	[witiis]	'your calf-of-leg'
/suap+on+Vm/	[suapoon]	'burned by you'

c) A prefix with an empty vowel is filled by the root's first vowel:

/mVŋ+bala/	[mambala]	'to fence'
/mVŋ+keke/	[menkeke]	'to dig'
/mVŋ+goop/	[mongoop]	'to suck'
/nVŋ+tete/	[nentete]	'to signal'
/nVŋ+tulun/	[nuntulun]	'to help'

d) A cluster of sonorant consonants is not allowed; they are repaired by deletion:

/miŋ+noa/	[minoa]	‘to breath’
/niŋ+ŋoap/	[niŋoap]	‘yawned’
/toŋ+yooŋ/	[toyoŋ]	‘unintentionally shake’
/saŋ+wuras/	[sawuras]	‘one seed’
/saŋ+loloŋ/	[saloloŋ]	‘one thousand’

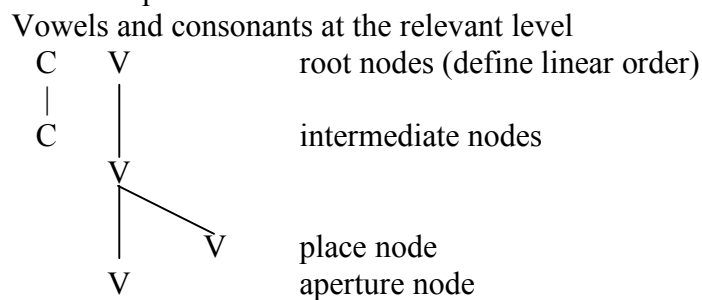
e) Interestingly, if a prefix contains an empty position and ends in a sonorant, then vowel epenthesis applies; the empty position is filled by the root’s first vowel:

/mVŋ+wawau/	[maŋawawau]	‘to do’
/mVŋ+memel/	[meŋememel]	‘to cool’
/mVŋ+limbaŋ/	[miŋilimbaŋ]	‘to move’
/mVŋ+roŋor/	[moŋoroŋor]	‘to hear’
/mVŋ+yuŋgot/	[muŋyuyŋgot]	‘to shake’

The constraints we need:

1. NOSPREAD; A feature may only occupy *one* syllable-head position
2. MAX-C
3. MAX-MORA; A mora in the input must correspond to a mora in the output (do not delete a mora)
4. FILL-MORA; A mora must be filled
5. DEP-V<sub>INT</sub>; An intermediate V-node in the output must correspond to an intermediate V-node in the input (do not insert an intermediate V-node)
6. AFFIXALIDENTITY (funny version); A prefix is a prefix and a suffix is a suffix
7. AFFIX-to-PROSODY (informal); an affixal mora occupies a dependent position.

The representations we need:



Possessive and infinitive morphemes in Balantak



The forms in a) follow straightforwardly from the representations of the two affixes. The empty mora is filled by the final vowel of the root (morpheme).

In the forms in b) the consonant cannot move into the root. That is blocked by the root's final consonant. Syllabification of the affixal consonant is only possible if the empty mora is filled, either by spreading, or by insertion. None of these repairs apply, so we can rank:

DEP-V<sub>INT</sub>, NOSPREAD » MAX-C

saratVm	DEP-V <sub>INT</sub>	NOSPREAD	MAX-C
☞ saraat			*
saratam		*!	
saratim	*!		

c) A prefix with an empty mora can never move into the root. This is a consequence of the undominated status of AFFIXALIDENTITY and AFFIX-to-PROSODY. If it would move, the consonants would have to be deleted, due to syllable structure. The free mora would have to be syllabified in the second position of the long vowel. This would make the mora irrecoverable as a prefix. In sum, a prefix with a free mora cannot do what a suffix with a free mora can do (move into the root).

The forms in c) allow us to determine another ranking;

DEP-V<sub>INT</sub> » NOSPREAD

mV <sub>η</sub> +bala	DEP-V <sub>INT</sub>	NOSPREAD
☞ mambala		*
mimbala	*!	

d) The rankings already established also explain why an illicit consonant cluster (two adjacent sonorants) is repaired by deletion, rather than by vowel insertion. Just inserting a V-root node is not enough (that still violates FILL-MORA). However, it is not possible to fill the mora by inserting an intermediate V-node. It is better to delete a consonant than to insert an intermediate V-node, as we have already seen.

e) To account for these forms we must rank MAX-C above DEP-MORA and DEP-ROOT.

MAX-C » DEP-MORA, DEP-ROOT.

mV <sub>η</sub> +wawau	MAX-C	DEP-MORA	DEP-ROOT
☞ maŋawawau		*	*
mawawau	*!		

Notice that high ranking DEP-V<sub>INT</sub> is not violated, because the new mora is filled by the spreading vowel of the root.