Harmony, Markedness, and Phonological Activity*

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0. Introduction

(1) "It is commonly observed that redundant phonological features in language are inert, neither triggering phonological rules nor interfering with the workings of contrastive features. ... This distinction between 'active' contrastive and 'inactive' redundant features is expressed in the theory through the notion of (under)specification of features in phonology." (Itô, Mester & Padgett 1993:1)

View a redundant feature as an extreme case of a contextually unmarked feature
(e.g. [nasal] ⇒ [voice])
The problem addressed here is to explain the following very loose generalization:

(2) **Unmarked ⇒ Inactive**
Unmarked elements are less phonologically active.

(3) Underspecification theory: Unmarked, or predictable, elements are absent from representations during certain phonological processes, hence inactive.
Extremely appealing, simple and elegant, lots of explanatory power.
But could it be that, at least in some areas where it's been proposed, underspecification is really a shadow cast by a missing genuine theory of markedness?
In particular, would such a markedness theory have as a consequence **Unmarked ⇒ Inactive**?

(4) Motivations to seek alternatives to underspecification (Mohanan 1991, McCarthy & Taub 1992).
Now you see it, now you don't: Descriptive and explanatory challenges of properly ordering derivations
Reconciling/unifying underspecification explanation of coronal inactivity with feature-geometric accounts of coronal diversity
These problems vanish if the unmarked elements (e.g. [coronal]) are *present* but their very unmarkedness accounts for their inactivity

(5) Optimality Theory: Markedness and Harmony
'unmarked' [informal] → 'more harmonic' [formal] (Prince & Smolensky 1993 ≡ PS93)
(N.B., ***not*** 'more well-formed'; well-formedness in OT is binary, not gradient)
Our question: ¿Does OT entail:

(6) **More harmonic ⇒ Less active**
More harmonic elements are less subject than less harmonic elements to participate in what have traditionally been regarded as 'phonological processes.'

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(7) Too general and imprecise to be a potential theorem (e.g., would need an OT definition of 'phonological process').
Instead, examine several classes of 'phonological processes'; at this point, only superficially.
Organized by the kinds of markedness involved:

(8) Talk outline
- I. Structural Markedness: Coda Licensing
- II. Featural Markedness: Coronals
- III. Contextual Markedness (Feature Co-occurrence Restrictions): Vowel Harmony

(9) **Key Idea:** *(Absolute version)*

No marks ⇒ Invisible

In OT, outputs are evaluated and selected solely on the basis of the constraints they violate, or the *marks* they are assessed by these constraints.

A phonological element can be 'invisible' to the phonology even when present, *if it does not incur any marks* — i.e., if is literally 'unmarked.'

The absolute version states that an element which incurs no mark is phonologically invisible; an element which incurs a mark is potentially visible. Same idea also applies in a more subtle way:

(10) **Key Idea:** *(Relative version)*

Lower marks ⇒ Less active

In OT, the lower a constraint is ranked, the less *active*† it is in the phonology. A mark assessed by a low-ranking constraint functions almost like no mark at all.

If structure *u* incurs lower-ranked marks than structure *m*, then *u* will interact with fewer constraints than *m*.

†For a precise definition of 'active' as used here — the constraint actually rules out candidates — see PS93:82 (110) [Pāṇini's Theorem]

(11) Output Full Specification and OT

Output underspecification in OT risks underconstrained descriptive power, with two kinds of unmarkedness:

unmarkedness by absence ('filled in by phonetic interpretation')
unmarkedness with presence (present but incurring no or low-ranked marks)

Constraints to be considered, such as

*[+sonorant & −voice], *[+obstruent & +voice]

cannot be evaluated if 'unspecified' feature values in output truly mean *unspecified*, rather than implicitly meaning a particular feature value. In the latter case, the constraints would have to refer explicitly to absence of specification, making the underspecification more illusory than real (cf., e.g., Pulleyblank 1983, 1986), and the writing of constraints painful.

Will try to work with fully specified outputs, binary features.

I. Structural Markedness: Coda Licensing (<u>PS93:§§6,8</u>)

(12) Coda Licensing.

Relative to Onset, Coda is a marked syllable position. Fitting the generalization **Unmarked ⇒ Inactive**, Onsets are ‘invisible’ to phonological processes which operate in Coda position, e.g. those which delete segments in languages prohibiting codas, or those which delete featural material neutralizing contrasts which are not neutralized in Onset position.

In terms of constraints rather than processes, Coda Conditions (Steriade 1982, Itô 1986, Yip 1991) healthily outnumber Onset Conditions.

Caveat: This example has the defect that Onsets can violate constraints by their *absence*: most of the constraints we will consider are *satisfied* by absence, hence the (vacuous) well-formedness of unspecified material.

(13) Formal OT Analysis:

In OT, Coda is (universally) a less harmonic structural element than Onset, as a result of (PS93:§6) ...

ONS: Syllables have onsets.
−COD: Syllables lack codas.

The fact that Codas are less harmonic than Onsets entails that violations of FAITHFULNESS will occur to a consonant which would otherwise become a Coda, but not an Onset: these violations (*PARSE, *FILL) correspond to traditional ‘deletion and epenthesis processes’ (respectively).

(14) Example: CV Theory

Consider a Σ^{CV} language in which the prohibition on codas is enforced by underparsing.

Input	Outputs	FILL^{Nuc}	−COD	PARSE	ONS
/CV**C**/ →	.CV**C**.		* !		
	☞ .CV⟨**C**⟩.			*	
/**C**V/ →	☞ .**C**V.				
	.⟨**C**⟩V.			* !	*

Constraints
FILL^{Nuc}: *□́
−COD: *C $_{\sigma}$]
PARSE: *⟨X⟩
ONS: *[$_{\sigma}$ V

(15) Exemplifies **No marks ⇒ Invisible** idea:

a. The relevant ‘phonological process’ here, in derivational terms, is C-deletion (same story could be told for V-epenthesis, with the Coda prohibition enforced by overparsing).

b. This corresponds in OT to the constraint violation *PARSE (or *FILL^{Nuc}).

c. By the fundamental principles of OT, such a violation must be forced: they arise only because the alternatives incur higher-ranking violations.

d. When faithful parsing of a C would create a Coda, this faithful alternative *does* incur a higher-ranking violation: it is only the mark *−COD which allows the would-be Coda to be phonologically visible.

e. When faithful parsing of a C would create an Onset, this faithful alternative incurs no marks: there is nothing to force violation of PARSE (or FILL^{Nuc}).

f. The Coda, but not the Onset, appears ‘visible’ to the ‘processes’ because the Coda, but not the Onset, incurs a mark.

Moving from the Basic CV Syllable Theory of PS93:§6 to the Basic Segmental Syllable Theory of PS93:§8, the fact that codas incur the mark *–COD but onsets are unmarked has the following consequence:

(16) **Thm: Onset/Coda Licensing Asymmetry** (PS93:§8; (258), p. 160)
There are languages in which some possible onsets are not possible codas, but no languages in which some possible codas are not possible onsets.

(17) This result is achieved as follows:

a. The non-binary universally constraint:

HNUC: $\acute{a} \succ \acute{i} \succ \cdots \succ \acute{t}$, i.e., Nuc/*a* ≻ Nuc/*i* ≻ ··· Nuc/*t*

is realized through a *universal sub-hierarchy of binary constraints*:

Peak Hierarchy: *Nuc/*t* ≫ ··· ≫ *Nuc/*i* ≫ *Nuc/*a*

b. Analogously, assume a universal subhierarchy for Onset/Coda = Margin = 'Mar'

Margin Hierarchy: *Mar/*a* ≫ *Mar/*i* ≫ ··· ≫ *Mar/*t*

c. Each sub-hierarchy is universally ranked internally, but the two inter-digitate in language-particular ways.

d. Other constraints (crucially, PARSE, FILL^{Nuc}, –COD, ONS) are inserted into these sub-hierarchies in language-particular positions.

e. The result is a typology of sonority-based inventories of possible Onsets, Nuclei, and Codas, about which (16) can be proved.

(18) **General Technique:** Typology by re-ranking, subject to universal domination conditions relating constraints on association (e.g., of Nuc to segments of varying sonority). Use this here.

(19) **Constraint Encapsulation:**

a. May get many constraints, but analysis shows that ranking- (i.e., language-) specific groups of constraints can be encapsulated into single, equivalent, constraints; e.g.,

b. POSS-NUC(π_{Nuc}): Segments with sonority less than π_{Nuc} may not be parsed as nuclei.

c. This encapsulates the portion of the Peak Hierarchy:

[*P/*t* ≫ ··· ≫ *P/τ]

from the top down the point where it is cut by the lower-ranked of PARSE and FILL^{Nuc}.

d. This encapsulated constraint has a parameter (π_{Nuc}, the sonority level just above that of τ).

e. The parameter value is determined entirely by the language-particular ranking.

II. Featural Markedness: Coronals

(20) **The challenge:**

"Mohanan (1989), in an overview of underspecification theories, suggests that (at least some of) the phenomena attributed to underspecification could be handled by a theory of markedness ... It is not clear how such an approach would handle any of the various arguments presented here for the special status of coronals:

the coda and cluster conditions, [II.5,4]
assimilation, [II.6]
neutralization, [II.5]
transparency, [II.7; III]
deletion, [II.3]
epenthesis, [II.2]
substitution, the frequency of coronal harmonies, etc.

It is even less clear how it could connect all of these properties together." [Paradis & Prunet 1991 ≡ PP91, p. 21]

(21) **The questions:**

a. ¿How many of these effects can we explain (and thereby "connect") via the Key Idea:

Lower marks ⇒ Less active

b. ¿Can we connect these effects with

coronal diversity [II.4]
universal markedness patterns in segmental inventories (presence/absence) [II.1]
constrastiveness of features in segmental inventories [III]
markedness effects within segmental inventories [III]
(e.g., target conditions on feature spread)

II.1 Generating Segmental Inventories in OT (PS93:§9.1–2)

(22) Segments are viewed as the parsed *outputs* from a rich base, not a restricted set of *inputs*.

Input: {PL, Lab} Output_1: **PL/Lab** Output_2: **PL**/Cor ⟨**Lab**⟩

If constraints are ranked so Output_1 is optimal, then have labials in the inventory.

(23) **Coronal Unmarkedness (Association Harmony version)**

PL/Cor ≻ PL/Lab

(24) **Coronal Unmarkedness (Association Constraint Sub-Hierarchy version)**

*PL/Lab ≫ *PL/Cor

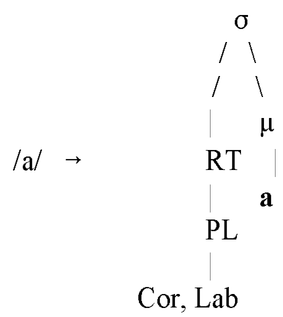
(25) **Implicational Inventory Universal (Theorem):**

Lab ⇒ Cor. If labials are present in an inventory, so are coronals.

II.2 Epenthesis

(26) PP91 (p. 21) claim that coronal underspecification correctly predicts that coronals, along with glottals, will be epenthetic consonants. [Focus on Lab *vs.* Cor, ignore glottals]

(27)



Candidates	***PL/Lab**	*Epenthesize Onset* ONS	PARSE	FILL^{Ons}	FILL^{PL}	***PL/Cor**
☞ σ/RT/PL/Cor				*	*	*
σ/RT/PL/Lab	* !			*	*	
⟨**a**⟩			* !			
σ/μ/**a**		* !				

N.B.: In the tableaux in this handout, grey marks cells as *central* to the argument.

(28) Notes:

a. σ/RT/PL is not admitted by *Gen* in this fully-specified approach (if present, PL must have a value)

b. Each output contains the input as an identifiable substructure; it is indicated here in **boldface**.

c. **Advertisement:** Nearly all tableaux in this paper, including this one, represent *stratified hierarchies* in a canonical form, automatically determined from the data via a *learning algorithm*:

$$\{\mathbb{C}_1, \mathbb{C}_2, \mathbb{C}_3\} \gg \{\mathbb{C}_4, \mathbb{C}_5\}$$

represented in the tableau as

$$\| \ \mathbb{C}_1 \ \vdots \ \mathbb{C}_2 \ \vdots \ \mathbb{C}_3 \ | \ \mathbb{C}_4 \ \vdots \ \mathbb{C}_5$$

See Tesar & Smolensky (1993, this workshop; Technical Report CU-CS-678-93)

(29) **The point:** The universal domination relation *PL/Lab ≫ *PL/Cor entails that, *ceteris paribus*, epenthetic consonants are coronals.

Epenthetic material should be as ‘invisible’ as possible: Cor achieves this with its universally low mark (relative to alternatives).

II.3 Deletion

(30) PP91 (p. 2) claim that coronal underspecification explains the invisibility of coronals to deletion in Japanese (citing Grignon 1984:324). An idealization of the intended situation might be (behavior of *s* in the verbal paradigm; thanks to Itô & Mester, p.c. — but the blame goes to me):

/~VC_1+C_2V~/	→ ~V.⟨C_1⟩C_2V~	if C_1 = Lab
	→ ~V.C_1□́.C_2~	if C_1 = Cor
/~VC_1+V~/	→ ~V.C_1V~	if C_1 = Cor or Lab

(31) **Cor invisibility to deletion**

Inputs	Outputs	Σ^{CV} –COD,ONS, FILL^{Ons}; FILL^{PL}	[Lab] → ∅ ***PL/Lab**	[Lab] → ∅ PARSE	[Cor] → [Cor]□́ ***PL/Cor**	[Cor] → [Cor]□́ FILL^{Nuc}
[Lab]+C_2	☞ ⟨[Lab]⟩.C_2			*		
	.[Lab]□́.C_2		* !			*
[Cor]+C_2	☞ .[Cor]□́.C_2				*	*
	⟨[Cor]⟩.C_2			* !		
[Lab]+V	☞ .[Lab]V.		*			
	⟨[Lab]⟩.V.	*ONS !		*		
	⟨[Lab]⟩.□V.	*FILL^{Ons} !		*		
[Cor]+V	☞ .[Cor]V.				*	
	⟨[Cor]⟩.V.	*ONS !		*		

(32) **The point:** The 'deletion process' corresponds to outputs with *PARSE.
The Labial is 'visible' to this process because *PL/Lab ≫ PARSE.
The coronal is 'invisible' to this process because PARSE ≫ *PL/Cor.
This constrast is possible because *PL/Lab ≫ *PL/Cor.
Since this domination is universal, it would not be possible to have a language with this same pattern except with Cor 'visible' and Lab 'invisible'.
If Cor deletes (i.e. ⟨[Cor]⟩ is optimal), then Lab must delete too (⟨[Lab]⟩ is optimal), but not conversely — part of the implicational inventory universal **Lab ⇒ Cor** (PS93:186)

Because PARSE ≫ FILL^{Nuc}, the CV analysis of PS93:§6 says that this language's prohibition of Codas is enforced by overparsing. Here, the Basic CV Theory has been enriched with the constraints *PL/Lab, *PL/Cor, which entail that underparsing avoids new marks that are not avoided in overparsing. The lower mark *PL/Cor is low enough that the conclusion is unaffected for coronals: overparsing is optimal. But the higher mark *PL/Lab is high enough that it does change the conclusion: avoiding it by underparsing is optimal.

II.4 Cluster Conditions and Local Conjunction

(33) "In monomorphemic words, English clusters never include more than one non-coronal...

CLUSTER CONDITION

Adjacent consonants are limited to at most one Place specification."(Yip 1991:63)

(34) a. In addition to *PL/Lab ≫ *PL/Cor, for multiple associations to a common node need

Composite Coronal Unmarkedness (CCU).

*PL/Lab,Lab ≫ *PL/Lab,Cor ≫ *PL/Cor,Cor

b. This is needed for inventory analysis of complex PLaces (improving on PS93:§9.1.2, addressing problem pointed out by John McCarthy w.r.t. 'SHARC' property).

c. **Local Conjunction:** *Local* interaction (multiple association to a node PL/Lab,Cor) vs. *non-local* interaction (PL/Lab at one RT and PL/Cor at another RT): local, by CCU (a): conjunctive constraints; non-local, by multiple marks. CCU (a) follows from:

*X; *PL/Lab ≫ *PL/Cor ⇒ *PL/Lab&X ≫ *PL/Cor&X

d. If assume that consonant clusters involve local interaction, can get Cluster Conditions via *PL/Lab,Lab ≫ {PARSE^{F}, FILL^{PL}} ≫ *PL/Lab,Cor ≫ *PL/Cor,Cor

e. This is a case of 'banning (only) the worst of the worst': requires Local Conjunction.

f. Closely related to Sequential Markedness Principle of Clements 1988:36; roughly:

A ≻ B ⇒ XAY ≻ XBY

II.5 Neutralization and Coda Conditions

(35) PP91 (p. 13) claim that coronal underspecification explains why coronals meet coda conditions which prohibit codas to have their own PL specification, and why contrasts are neutralized in coda position, with coronals surfacing (p. 9) (e.g., Yip 1991).

(36) The Coda cond is extremely elegant, but must be stipulated.

Here, the result is derived as a 'worst-of-the-worst' effect, from the markedness of both

Cod (via *−COD)

and

Lab (via *PL/Lab ≫ *PL/Cor).

(37) a. The Local Conjunction of these two gives

*PL/Lab&Cod ≫ *PL/Cor&Cod

where *PL/F&Cod is violated when PL is F in a Coda segment.

b. If PARSE^{RT} intervenes betweeen the two constraints in a., Lab segments will be unparsed rather than parsed into Coda position (but will be parsed into Onset position).

c. If PARSE^{F} and FILL^{PL} intervene (and PARSE^{RT}, FILL^{Nuc} are higher-ranked than both), in Coda (but not Onset) position, a Lab input segment will be parsed as a Cor: Lab assimilates to Cor in Coda position.

II.6 Assimilation

Why does /[Cor][Lab]/ → 〈[Cor]〉[Lab] and not *[Cor]〈[Lab]〉? Apparently, anti-harmonic, unless (contrary to our hypothesis) [Cor] is unspecified in input. Open problem.

II.7 Transparency

PP91 refer to transparency of coronals to vowel feature-spread; prefer to move on to consider spread and contextual markedness more generally.

III. Contextual Markedness (Redundancy, Feature Co-occurrence Restrictions): Vowel Harmony

III.1 Transparency in Vowel Harmony

(38) **Focal Questions:**

a. Can **Lower marks ⇒ Less active** explain why redundant features tend to be phonologically inactive?

b. Does our inventory theory (§II.1) provide a deductive link from constraint rankings which *produce* inventory gaps (hence redundancy) to the inactivity effects?

!☞ **Goal:** Show how consequences of inventory shape are inevitable consequences of the constraint rankings which are responsible for producing that inventory in the first place.

(39) **Transparent Vowels** When gaps in inventories make a feature value −F redundant for some segment, harmony rules that spread +F often operate as though the redundant −F were absent.

(40) **Finnish** *i* and *e* lack back counterparts in the inventory (*ü/u, ö/o, ä/a, i, e*) and are transparent to spread of [+Back]. (Kiparsky 1980, Goldsmith 1985, etc.)

(41) a. Adopt naive binary feature theory.

b. Harmonically alternating suffix vowels assumed (as usual) to be underspecified **in input** for Back.

c. Assume the following universal domination relations (shortcut from more basic feature co-occurrence constraints) (compare *PL/Lab ≫ *PL/Cor):

*+B/I ≫ *−B/I   I ≡ [−rd & +hi & −lo] (¿from *[+B & −lo & −rd])

*−B/O ≫ *+B/O   O ≡ [+rd & −hi & −lo] (¿from *[−B & +rd])

etc.

(42) Finnish inventory

ɨ absent; *+B/I is surface-unviolated:	*+B/I ≫	PARSE^F, FILL^F
i present: *−B/I is surface-violated:		PARSE^F ≫ *−B/I
ö present: *−B/O is surface-violated:		PARSE^F ≫ *−B/O ≫ *+B/O

gives implicational universal: *ö* in inventory ⇒ *o* in inventory

(43) Inputs, Outputs, Constraints for vowel harmony

$[_{+B}$ $[_{-B}$]]
O ··· **I**··· **O**
|
+B
phonetic: *o* ··· *i* ··· *o*

ALIGN^{+B}: Align rt edge of +B-domain with rt word edge (gradient).†
FILL^{B}: A ±B-domain contains an underlying ±B feature.
PARSE^{B}: An underlying ±B feature is parsed into a ±B-domain.
*EMBED: A RT node is parsed into a non-embedded B-domain.
*+B/I, etc., are evaluated against deepest B-domain (like phonetic int.)
†McCarthy & Prince 1993a,b: ALIGN(±B-domain,Rt;Wd,Rt)

(44) **Transparency**

	Produces Inventory Gap							
	***+B/I**	FILL^{B}	PARSE^{B}	***−B/I**	ALIGN^{+B}	*EMBED^{B}	*−B/O	*+B/O
O ··· I ··· O | +B →								
☞ $[_{+B}O[_{-B}I]O]$ *oio*		*		*		*		* *
$[_{+B}O\ I\ O]$ *oɨo*	* !							* *
$[_{+B}O[_{-B}I\ O]]$ *oiö*		*		*		* *!	*	*
$[_{+B}O][_{-B}I\ O]$ *oiö*		*		*	*IO !		*	*
$[_{-B}O\ I\ O]$ *öiö*		*	* !	*			* *	
O ··· I ··· O | | +B −B →								
☞ $[_{+B}O[_{-B}I]O]$ *oio*				*		*		* *
$[_{+B}O\ I\ O]$ *oɨo*	* !		*					* *
$[_{+B}O[_{-B}I\ O]]$ *oiö*				*		* *!	*	*
$[_{+B}O][_{-B}I\ O]$ *oiö*				*	*IO !		*	*
$[_{-B}O\ I\ O]$ *öiö*			* !	*			* *	

(45) **Opacity**
If exchange ALIGN^{+B} and *EMBED, the optimal form becomes
$[_{+B}O][_{-B}I\ O]$ = *oiö*
i.e., *i* switches from *transparent* to *opaque* (typology by re-ranking)

(46) **Input Underspecification**

a. It makes no difference whether I is unspecified for Back in the input.

b. The only marks that change if I is underlyingly –B are those from $\text{F}\textsc{ill}^{\text{B}}$ (because a –B-domain containing *i* is now filled by underlying –B); but the *$\text{F}\textsc{ill}^{\text{B}}$ marks in the first input are irrelevant anyway, since violation of $\text{F}\textsc{ill}^{\text{B}}$ is forced by higher-ranked *+B/I.

c. [This conclusion holds even if the underlying specification for I is +B!]

d. So 'transparency' of I has nothing to do with underspecification.

e. Irrelevancy of input underspecification is also an important feature of the account of Itô, Mester & Padgett 1993:15–16, although their goal is *output* underspecification.

(47) **The point.**

The feature –B for I appears to be invisible because the marks *–B/I which it generates are irrelevant (the constraint *–B/I is 'inactive' in the technical sense of PS93:82).

These marks are irrelevant because they are shared by all candidates which pass the high-ranking constraint *+B/I.

This constraint must be high-ranking because the inventory lacks *ɨ*.

Thus the invisibility of –B for I is a direct consequence of its redundancy.

III.2 Effects of <u>target</u> Harmony in vowel harmony

(48) **Surface-false feature co-occurrence restrictions.**

a. Constraints like *+B/I can be active even in languages in which they are not surface-unviolated.

b. Thus we expect to see in a language which possesses *ɨ* some effect of its mark *+B/I.

c. That is, the same constraints (like *+B/I) which account for typological markedness via implicational universals on inventories (e.g., *ɨ* ⇒ *i*), deriving from the Boolean distinction between surface true/false in the language, should also function in languages where they are surface-violated, manifesting themselves as effects of the relative markedness of members of the same inventory.

(49) **Turkish Disharmonic Roots.** Within Turkish roots, exceptions are common to vowel harmony (agreement on Back, high vowels agreeing with preceding vowel on Round). However, within morphemes:

> "The vowels /ü, ö, ɨ/ do not occur disharmonically in VC_0V sequences, except that /i, ü/ may occur in either order." (Clements & Sezer 1982:228)

(Do not treat the exception here; consider only *ɨ*, but *ü* and *ö* should be analogous.)

(50) **Markedness and Turkish Root Disharmony.**

	Fill^{B}	Align^{B}	***+B/I**	Parse^{B}	*Embed^{B}	***−B/I**	*+B/E	*−B/E
E E E → | | **−B +B**								
☞ $[_{-B}E[_{+B}EE]]$ *eaa*					* *		* *	*
$[_{-B}E][_{+B}EE]$ *eaa*		*EE !					**	*
$[_{-B}E[_{+B}E]E]$ *eae*		*E !			*		*	**
$[_{-B}E\ E\ E]$ *eee*				* !				***
$[_{+B}\ E\ E\ E]$ *aaa*				* !			***	
E I E → | | **−B +B**								
$[_{-B}E[_{+B}IE]]$ *eɨa*			* !		* *		*	*
$[_{-B}E][_{+B}IE]$ *eɨa*		*IE !	*				*	*
$[_{-B}E[_{+B}I]E]$ *eɨe*		*E !	*		*			**
☞ $[_{-B}E\ I\ E]$ *eie*				*		*		**
$[_{+B}EIE]$ *aɨa*			* !	*			**	
I I → | **+B**								
☞ $[_{+B}\ I\ I]$ *ɨɨ*			* *					
$[_{+B}\ I\ [_{-B}I]]$ *ɨi*	* !		*		*	*		
$[_{-B}\ I\ I]$ *ii*	* !			*		* *		

(51) **ATR harmony**.

a. This result relates to work of Archangeli & Pulleyblank (..., 1992, ...) on African ATR harmony systems, where they show that the typological propensity for ±ATR to spread to a segment depends on how well ‘grounded’ phonetically the association of this feature would be.

b. In present terms: whether a feature will spread to a segment depends on how harmonic the resulting feature co-occurrences would be. Vowel harmony systems can be arranged so that spread of a feature to a target is conditioned by the potential Harmony of the target after spread, as assessed by a collection of feature co-occurrence constraints.

III.3 Effects of <u>source</u> Harmony in vowel harmony

(52) The Archangeli & Pulleyblank work shows also that whether a feature will spread can depend on the Harmony ('well-groundedness'?) of the *source*.

(Note: this seems counter to the Assimilation generalization which was unexplained in §II.6)

(53) **Problem:**

a. From the perspective adopted here, it is clear why *target* Harmony can matter: relevant competitors differ on the target, and parses which produce higher Harmony outputs are favored.

b. But why should competition between forms differing in the target but not in the source be affected by the Harmony of the *source*?

c. Methods discussed above do not seem to provide an answer.

(54) Very tentative suggestion:

a. Unify
cross-positional & within featural constraints like *[+ATR][–ATR]
with
within-positional & cross-featural constraints like *[+Hi & –ATR]

b. A feature co-occurrence constraint *[F & G] is the most dominant member of a family:
*[F]β[G]
where β is intervening material; the 'smaller' β, the more dominant the constraint

c. E.g.
*[+Hi & –ATR] ≫ *[+Hi]μμ[–ATR] ≫ *[+Hi]σσ[–ATR]

d. Note that the constraints demanding ATR harmony are in this family:
*[+ATR & –ATR] ≫ *[+ATR]μμ[–ATR] ≫ *[+ATR]σσ[–ATR]

e. So more harmonic sources are stronger because they consist of a set of features which agree in their influence on their neighbors: a source which is [+ATR & +Hi] has *two* constraints disfavoring [–ATR] in a right neighbor separated by β:
*[+ATR]β[–ATR] and *[+Hi]β[–ATR]

Preliminary work suggests this can actually be implemented in OT for Lango.

(55) **'Tradeoff' and rule evaluation.**
For typology, this would mean that Archangeli & Pulleyblank's 'tradeoff' in evaluating *rules* would be replaced by re-ranking of constraints that evaluate *representations*.

V. Summary

The point: A wide range of phenomena that have been attributed to underspecification can be accounted for in a simple, uniform way, using only the central grammatical apparatus of OT, without stipulating a separate representational device for unmarkedness: invisibility. 'Invisibility' is a *derived* property:

(56) **'Process' Marks ≫ Element Marks ⇒ Element is 'invisible' to 'process'**

Section	*Visible Element* Mark	≫	***Condition/Process*** Mark	≫	*Invisible Element* Mark
§I	*Coda* *–COD	≫	***Coda Prohibition*** *PARSE or *FILL^{Nuc}	≫	*Onset* ∅
§I.2	*Epenthetic Labial* *PL/Lab	≫	***(Onset) Epenthesis*** *FILL^{Ons}, *FILL^{PL}	≫	*Epenthetic Coronal* *PL/Cor
§II.3	*Labial Segment* *PL/Lab	≫	***Deletion*** *PARSE^{PL}	≫	*Coronal Segment* *PL/Cor
§II.4	*Lab&Lab Cluster* *PL/Lab&Lab	≫	***Cluster Condition*** *PARSE^{F}	≫	*Lab&Cor or Cor&Cor Cluster* *PL/Lab&Cor ≫ *PL/Cor&Cor
§II.5	*Labial Coda Segment* *PL/Lab&Cod	≫	***Coda Neutralization*** *PARSE^{F}, *FILL^{PL}	≫	*Coronal Coda Segment* *PL/Cor&Cod
§II.6	*[Lab]* ??		***Assimilation*** ??		*[Cor]* ??
§III.1	 *+B/I	≫	***+B-spread*** *FILL^{B}, *PARSE^{B}	≫	*Redundant –B* *–B/I; ALIGN^{+B} ≫ *EMBED^{B}
§III.2	*+B/I = ɨ* *+B/I	≫	***Del. Disharmonic +B*** PARSE^{B}, *EMBED^{B}	≫	*+B/E = a* *–B/I, *+B/E

(57) Sometimes, rather than Structural Invisibility, what may be at work is **Mark Invisibility** (10):
Lower marks ⇒ Less active