The Morphology-Phonology Connection

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1 Introduction

- Morphology: generalizations about form and meaning that relate words to one another within a language
- Phonology: generalizations about the sound patterns in that language
- The statement of many morphological generalizations includes information about sound patterns (realizational morphology); the statement of many phonological generalizations includes information about morphology (morphologically conditioned phonology), blurring the distinction between morphology and phonology in many situations.
- Three approaches relevant to this aspect of morphology-phonology interface:
    - Cophonology Theory (e.g. Orgun 1996, Inkelas 1998, Anttila 2002, 2007, 2008, 2009, Inkelas and Zoll 2005, 2007)
    - Stratal Optimality Theory (e.g. Kiparsky 2000, 2003a, b, 2007, 2008)
    - Indexed Constraint Theory (e.g. McCarthy and Prince 1995, Smith 1997, Kiparsky 2000, 2003a, b, Itô and Mester 1999, Alderete 2001, Pater 2000, 2009).

2 Claim of paper

The ideal theory will capture these generalizations:

SUBSTANCE: Morphologically conditioned phonology and realizational morphology involve the same operations

SCOPE: Morphologically conditioned phonology and realizational morphology have identical scope of application within a word

LAYERING: Morphologically conditioned phonology and realizational morphology are identical in their interactions in complex words

3 Morphologically conditioned phonology (MCP)

MCP: a particular phonological pattern is imposed on a proper subset of morphological constructions (affix, reduplication, compounding) and thus is not fully general in the lexical phonology of the language.

Example 1: Mam (Willard 2004, based on England 1983). 'Dominant' affixes cause long root vowels to shorten (1a); 'Recessive' suffixes preserve root vowel length (1b). Dominant vs. recessive status must be learned individually for each affix.

(1)

a.	Dominant suffix: shortens long root vowel				
	facilitative	l**ii**ch'-	→	lich'-ich'iin	'break/breakable'
	resultant locative	j**uu**s-	→	jus-b'een	'burn/burned place'
	directional	j**aa**w-	→	jaw-nax	'go up/up'
	participial	n**oo**j-	→	noj-na	'fill/full'
b.	Recessive suffix: preserves root vowel length				
	intransitive verbalizer	muq-	→	muq-oo	'bury (n.)/bury (v.)'
		b'**ii**tz-	→	b'**ii**tz-oo [b'liitza]	'song/sing'
	instrumental	luk-	→	luk-b'il	'pull up/instr. for pulling up'
	remainder	w**aa**-	→	w**aa**-b'an	'eat/remains of food'

Example 2: Malayalam (Mohanan 1995:52). Gemination applies at the internal juncture of subcompounds (head-modifier) (b) but not at the internal juncture of cocompounds (coordinate) (c):

(2)

a.	meeşa	'table'	petti	'box'
	kasaala	'chair'	-kaḷə	(plural suffix)
b.	[meeşa-ppetti]$_S$ –kaḷə		'boxes made out of tables'	
c.	[meeşa-petti]$_C$ -kaḷə		'tables and boxes'	

Example 3: English. Suffixes fall into two classes (e.g. Allen 1978, Siegel 1974, Chomsky and Halle 1968, Kiparsky 1982a):

(3)

Base	Stress-shifting suffix	Non-stress-shifting suffix
párent	parént-al	párent-ing
président	prèsidént-ial	présidenc-y
áctive	àctív-ity	áctiv-ist
démonstràte	demonstrative	démonstràtor

Unifying thread: some morphological constructions in the language (affixation, compounding) are associated with a pattern that other constructions (other affixation, other compounding) are not.

4 Realizational (process) morphology (RM)

RM: a morphological category is exponed by a phonological process other than additive combination of phonologically contentful morphemes.

Example 1: Tohono O'odham (Yu 2000:129-30, citing Zepeda 1984; Anderson 1992, citing Zepeda 1983**)**. Perfective verbs derived from imperfectives by deleting a final segment (or $V_{[+hi]}C_{[+cor]}$):

(4)

Imperfective	Perfective	gloss	data source
síkon	síko	'hoe object'	Yu 2000
híwa	híw	'rub against object'	Yu 2000
hiːnk	hiːn	'bark'	Anderson 1992

Example 2: Keley-i (Malayo-Polynesian; Samek-Lodovici 1992, citing Reid 1975, Schachter 1976, Hohulin & Kenstowicz 1979). Nonperfect aspect marked by consonant gemination, providing a coda to what would otherwise be the leftmost light syllable (5a-c). Blocked in words with all closed (heavy) syllables (5d, object and subject focus):

(5)

		(a)	(b)	(c)	(d)
	Base:	pili	duyag	ʔagtu	duntuk
Non-perfect aspect	Object focus:	pi**ll**i	du**yy**ag	ʔagtu	duntuk
	Access. focus:	ʔi-**pp**ili	ʔi-**dd**uyag	ʔi-ʔʔagtu	ʔi-**dd**untuk
	Subject focus:	um-pi**ll**i	um-du**yy**ag	man-ʔagtu	um-duntuk

Example 3: English (e.g. Kiparsky 1982b). Stress shift marks the conversion from verbs to nouns.

(6)

condúct	→	cónduct
abstráct	→	ábstract
recórd	→	récord

Unifying thread: a non-additive phonological process is the only systematic distinguishing marker of a morphological operation

5 Sketches of three approaches to morphologically conditioned phonology

Three theories designed to cover morphologically conditioned phonology, presented, for maximum comparative effect, in their strictest versions, ignoring nuanced variations of each.

5.1 Cophonology theory (e.g. Anttila 2002, 2007, 2008, Inkelas 1998, Inkelas et al. 1997, Inkelas and Zoll 2005, 2007, Orgun 1996)

- A member of the family of construction grammar theories (e.g. Goldberg 2006, Koenig 1999, Riehemann 1998, Booij to appear)
- The morphological grammar consists of a set of word-building constructions, each embodying both a meaning function (inflectional, derivational, the identity function) and a form function or 'cophonology', e.g. a set of ordered phonological rules or ranked constraints.

Example: *-ify* construction in English. *f(x)* cophonology concatenates input stem with string *–ify* and performs (re)syllabification, stress shift, Trisyllabic laxing, velar softening:

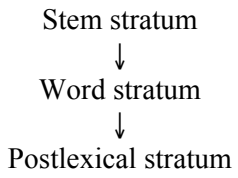
(7)

- Each individual morphological construction has its own, potentially unique, cophonology. Comparative *–er* is associated with a cophonology that is stress-preserving (not stress-shifting), requires roughly monosyllabic inputs, and does not trigger Trisyllabic laxing or velar softening.
- Precedents for affix-specific cophonologies: Poser 1984, Bochner 1992.
- Similarities across cophonologies in a language are captured with meta-generalizations formalized as a 'grammar lattice' in Anttila 1997, 2002, 2007, 2008.

5.2 Stratal Optimality Theory (Stratal OT; Kiparsky 2000, 2003a, b, 2007, 2008)

- Descended from **Lexical Morphology and Phonology** (LMP; Kiparsky 1982a, b, 1984, 1985)
- Every language has three strata, each with its own phonological system:

(8)



- Phonological differences between *–ify* and *–er* would be modeled by assigning *–ify* to the Stem stratum, which imposes resyllabification, stress shift, Trisyllabic laxing and velar softening, and *-er* to the Word stratum, which imposes only resyllabification.
- **Stratal OT** = a restrictive version of cophonology theory in which every morphological construction is associated either with the 'Stem' or the 'Word' cophonology.

5.3 Indexed constraint theory (e.g. McCarthy and Prince 1995; Smith 1997, Itô and Mester 1999; Pater 2000, 2006, 2009; and Alderete 2001)

- **Cophonology theory** and **Stratal OT**: a language can have multiple grammars
- **Indexed Constraint theory**: each language has a single phonological grammar, but with morphologically indexed constraints. (Resembles *The Sound Pattern of English* (Chomsky & Halle 1968), with a single grammar containing minor rules.)
- MCP: handled by indexing constraints to individual morphological contexts, e.g Max-C_{root}, Max-C_{affix}, Max-C_{BR}, Align-stress-*ity*, etc.

Example: Assamese (Pater 2009, citing Mahatma to appear). [i] and [u] trigger regressive ATR harmony. With some [i]-initial suffixes, [a] is opaque; with others, [a] raises to +ATR [o] (or [e]):

[kɔpɑh]	'cotton'	[kɔpɑhi]	'made of cotton'	suffix /-i/
[zɔkɑr]	'shake'	[zɔkɑri]	'shake (infinitive)'	
[sɑl]	'roof'	[soliyɑ]	'roof'	suffix /-iyɑ/
[kɔpɑl]	'destiny'	[kopoliyɑ]	'destined'	

Next: test **Cophonology, Stratal OT, Indexed constraint** theories against three generalizations about RM and MCP: SUBSTANCE, SCOPE and LAYERING

6 SUBSTANCE: Realizational morphology and morphologically conditioned phonology overlap substantively to the point of being essentially indistinguishable.

6.1 Segment deletion

- RM in Tohono O'odham (4): final segment deletion marks perfective in verbs.
- RM in Lardil: final vowel deletion marks nominative case in Lardil (Blevins 1997:249, citing original sources):

(9)

NonFuture Accusative	Nominative	gloss
kentapal-in	kentapal	'dugong'
ngaluk-in	ngalu	'storey'
mayarra-n	mayarr	'rainbow'
mela-n	mela	'sea'

- MCP in Turkish: vowel hiatus arising at morpheme boundaries is repaired in most cases by glide epenthesis, but in one case – that of the progressive suffix *–Iyor* –by vowel deletion:

(10)

	C-final root		V-final root	
	'do'	'come'	'understand'	'say'
	yap	gel	anla	söyle
Facilitative/-Iver/:	yap-ıver	gel-iver	anl**a-y**ıver	söyl**e-y**iver
Progressive/-Iyor/:	yap-ıyor	gel-iyor	anl-ıyor	söyl-üyor

6.2 Gemination

- RM in Keley-i: marks nonperfect aspect in verbs (5)
- MCP in Malayalam: phonological accompaniment to subordinate compounding (2)
- RM in Woleaian: stem-initial C gemination forms denotatives (Kennedy 2003:174)

(11)

fili	→	ffili	'choose it/to choose'
βuga	→	bbuga	'boil it/to boil'
tabee-y	→	ttabe	'follow it/to follow'

- MCP in Hausa (Newman 2000:235, 425): prefixing pluractional verb reduplication includes a process of stem-initial gemination that other prefixing reduplication constructions do not exhibit:

(12)

búgà:	→	búbbúgà:	'beat'
dánnè:	→	dáddànné:	'press down, oppress'
gyà:rú	→	gyàggyà:rú	'be well repaired'

6.3 Truncation to a prosodic constituent

RM in Spanish (Pineros 2000:71): forms nicknames

(13)

Ricardo	→	Rica
Armando	→	Arma
Jesus	→	Jesu
Concepción	→	Conce

MCP in Swedish (Weeda 1992:121, citing original sources): accompanies affixation in nicknames:

(14)

a.	alkoholist	→	alk-is	'alcoholic'
	laboratori:um	→	labb-is	'lab'
b.	mats	→	matt-e	(proper name)
	fabian	→	fabb-e	(proper name)

6.4 Dissimilation and 'exchange' rules

Dissimiliation: segment surfaces with value opposite to that of another segment in the same word (syntagmatic)

Exchanges/toggles: segment surfaces with value opposite to that of its own input value (paradigmatic) (see survey in Kurisu 2001).

- RM in Nuer (Frank 1999): input/ouput vowel length dissimilation marks the singular/plural distinction in some nouns:

(15)

	Nominative singular	Nominative plural	gloss
a.	ley	leey	'animal(s)'
	wuɔ̱k	wuɔ̱ɔ̱k	'(upper) arm(s)'
b.	ka̱at	ka̱t	'vulture(s)'
	yieer	yiër	'river(s)'

- MCP in Hausa (Newman 2000:160ff., 598): 'stabilizer' clitics have a fixed segmental component (*ne:* for masculine, *ce:* for feminine) but exhibit tone polarity relative to the preceding syllable:

(16)

…L-H		…H-L	
gwàdò né:	'it's a blanket'	kè:ké nè:	'it's a bicycle'
zó:bè: né:	'it's a ring'	nán nè:	'it's there (by you)'
mó:tà: cé:	'it's a car'	ákwálá: cè:	'it's a piece of junk'
gó:nâ-ř cé:	'it's the farm'	rì:gá: cè:	'it's a gown'

6.5 Stress/pitch-accent (re)assignment

- RM in English: verb-to-noun conversion in (6)
- MCP in English: stress-neutral vs. stress-shifting suffixes (3)

6.6 Review:

- The phonological operations used in RM are essentially the same operations that, as MCP, can accompany overt affixation, reduplication and compounding (cf. Anderson 1975)
- Practical criterion (used above): a phonological alternation is classified as RM if it is the sole exponent of a morphological construction, but as MCP if it accompanies what is judged to be the primary exponent of a morphological construction (affixation, reduplication, compounding).

Duplication Problem

- In many cases it is difficult or impossible or pointless to determine whether a given phonological effect is primary (RM) or secondary (MCP).

(17) Hausa (Newman 2000). Tone replacement is RM in (17a) but RCP in (17c):

	base tone replaced	base tone preserved
zero derivation	✓	✓
overt affixation	✓	✓

a. No affixation; tone replacement (imperative formation)
   - ká:mà: → kà:má: 'catch (!)'
   - bíncìké: → bìncìké: 'investigate (!)'
   - nánné:mó: → nànnè:mó: 'seek repeatedly (!)' (< *né:mó:* 'seek')

b. No affixation, no tone replacement (Grade 2 verbal noun formation)
   - fànsá: → fànsá: 'redeem/redeeming'
   - tàmbáyà: → tàmbáyà: 'ask/asking'

c. Overt affixation, tone replacement (various plural classes)
   - má:làm → mà:làm-ái 'teacher-pl' -LH
   - rì:gá: → rí:g-únà: 'gown-pl' -HL
   - tàmbáyà: → támbáy-ó:yí: 'question-pl' -H

d. Overt suffixation, no tone replacement (various)
   - dáfà: → dáfà:-wá 'cook-ppl' -LH
   - gàjé:ré: → gàjé:r-ìyá: 'short-fem' -LH
   - hù:lá: → hù:lâ-ř 'hat-def' -L [ř] = trill, [r] = approximant

Paradox: Barasana mutual blocking (Pycha 2005, citing Gomez-Imbert and Kenstowicz 2000). Some Barasana suffixes affect stem tone. Non3rdSubj suffix *-bɨ* causes H tone to align all the way to the right in words containing it; Interrogative suffix *-ri* causes H to align all the way to the left

(18)

baa-bɨ HH H	'swim-**Non3rdSubj** = I/you/we swim'
baa-ri H	'swim-**Interrogative** = did he/she/they swim?'

Mutual blocking (Pycha 2005): The segmental components of Non3rdSubj and Interrogative cannot co-occur (18a), nor can their mutually incompatible effects on tone both be realized. In words where both meanings are desired, we find the segments of the Interrogative -- and the tones of the Non3rdSubj (18b):

(19) a. *baa-ri-bɨ, *baa-bɨ-ri 'did I/you/we swim?'
b. baa-ri 'did I/you/we swim?'
HH H

- Pycha: in (18), both Non3rdSubj, Interrogative achieve exponence, by using the segments of one and the cophonology of the other.
- Paradox: The tone of Non3rdSubject is RM when co-occurring with the Interrogative but MCP otherwise.

- Desired solution: somehow reduce both RM and MCP to the same formalism, even if for convenience they continue to be distinguished terminologically. Earlier work advocating this position: Anderson 1992, Bochner 1992, Dressler 1985, Ford and Singh 1983, 1985, Poser 1984, Singh 1987, 1996).

7 Theoretical discussion

How do Cophonology Theory, Indexed Constraint Theory and Stratal OT model RM and MCP?

7.1 **Cophonology theory** uses the same mechanism to account for so-called RM and so-called MCP.

Example: English truncation is modeled by a cophonology *g(x)* which maps an input to an output of a certain size, e.g. two syllables.

(20) *g(x):* a cophonology limiting the output to two syllables (σσ >> Max)

Truncation as RM	**Truncation as MCP**
g(*Rebecca*) = *Becca*	*g(Rebecca, -y)* = *Becky*
/Rebecca/	/X/$_{Stem}$ /-i/
(Realizational morphology)	*(Morphologically conditioned phonology)*

7.2 Indexed Constraint Theory: all phonological alternations are accomplished by the ranking of phonological constraints. Expectation: Indexed Constraint theory should make essentially the same predictions as in cophonology theory regarding the substance of realizational morphology and morphologically conditioned phonology**.**

Kurisu 2001: REALIZE-MORPH (indexed to particular morphemes) is a source of RM. REALIZE-MORPH requires that the phonological output of a morphological construction be non-homophonous with the input. REALIZE-MORPH requires a construction with no overt affix to undergo some phonological change, to be determined by the ranking of markedness and faithfulness constraints of the grammar. **Icelandic**: deverbal nouns are formed by deleting the final vowel from the infinitive:

(21)				
	klifra	→	klifr	'climb/climbing'
	grenja	→	grenj	'cry/crying'
	söötra	→	söötr	'sip/sipping'
	puukra	→	puukr	'conceal/concealment'

Dep, RM » Max; the need to satisfy RM compels a Max violation.

(22)

	/klifra/	RM	DEP	MAX
a.	klifra	!*		
b.	klifr			*
c.	klifrata		*!	

REALIZE-MORPH = indexed constraint, like Faith-BR (McCarthy & Prince 1995), Faith-Noun (Smith 1997, 1998, 2001), etc.

7.3 Stratal OT: has little to say about RM or its relation to MCP. Suited for generalizations holding over stems and words, not construction-specific alternations. As not all stem morphology in English is truncating, Stratal OT cannot identify the truncation in *Rebecca* → *Becca* with Stem phonology. Requires supplementation with indexed constraints or cophonologies, thus merging with the other approaches**.**

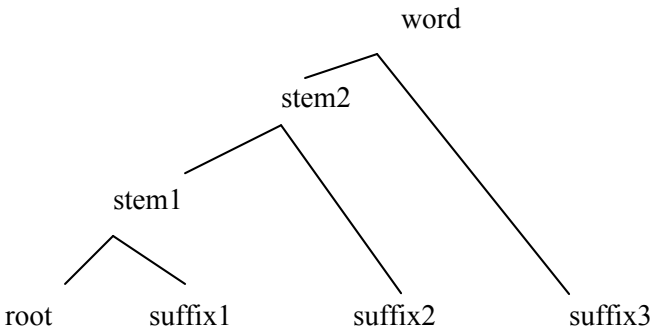
8 SCOPE

RM and MCP: the scope of the phonological effect(s) is the stem produced by the word formation process in question.

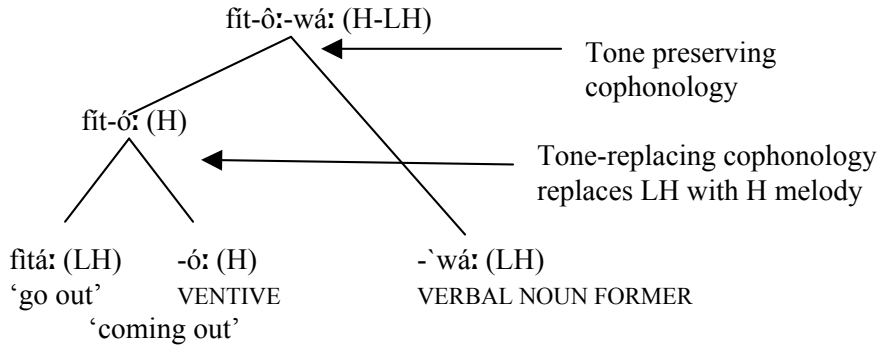
Cophonology Theory: the scope of each cophonology is the morphological subconstituent built by the associated construction.

Example: in a word with three suffixes, cophonology theory predicts that the cophonology of Stem2 can affect the surface form of Stem1 and Suffix2, but that the cophonology of Stem2 *cannot* affect the surface form of Suffix3

(23)



(24) Hausa ventive construction is tone-replacing (Newman 2000:663), e.g. *fìtá:* (LH) 'go out' → *fǐt-ó:* (H) 'come out'. Verbal noun former is tone-preserving (-*`wá*). Ventive can be converted to verbal noun. Ventive cophonology has scope only over ventive stem.



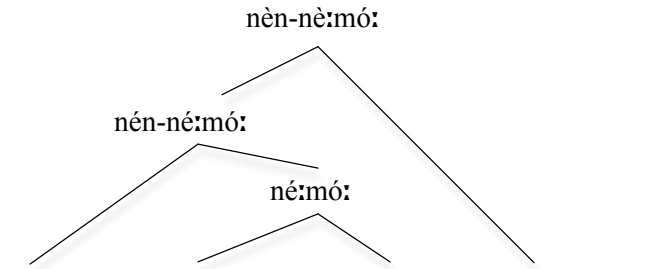
Ventive cophonology	Tone=H » Ident-tone, Tone = LH
-*`wá:* verbal noun cophonology	Ident-tone » Tone=H

Scope effects of this kind are an intrinsic prediction of cophonology theory.

Stratal OT makes correct scope predictions for effects in different strata (Word has scope over Stem, but not vice versa), but has trouble with effects that are not general within Stems or Words.

Hausa in Stratal OT: tone replacement = Stem-level; tone-preservation = Word-level. Works for (24). Problem: tone-replacement and tone-preservation are not stratally ordered:

(25)



Because Words and Stems are strictly ordered, Stratal OT strictly speaking cannot handle this case.

Indexed constraint theory: one constraint ranking for the entire language. The cophonologies in (24) can translate into indexed constraints (on what constraints can be indexed, see e.g. Ito & Mester 1999, Alderete 2001, Inkelas & Zoll 2007, Pater 2009)

(26) a. Ident-tone-$_{\text{wá:}}$ » Tone=H » Ident-tone
b. Tone=$H_{Ventive}$ » Ident-tone » Tone=H

What are constraints indexed to? Tone=$H_{Ventive}$ must refer to the entire ventive stem, not just the ventive suffix *-ó:*, to generate *nè:má: → né:mó:*. To capture SCOPE, recent work in Indexed Constraint theory has moved toward cophonology theory by indexing constraints to stems, not morphemes (e.g. Alderete 2001).

9 Layering

- A corollary of the scopal prediction of **cophonology theory**
- The effect in which, given a structure where X is a daughter of Y, the output of the cophonology associated with X is the input to the cophonology of Y.
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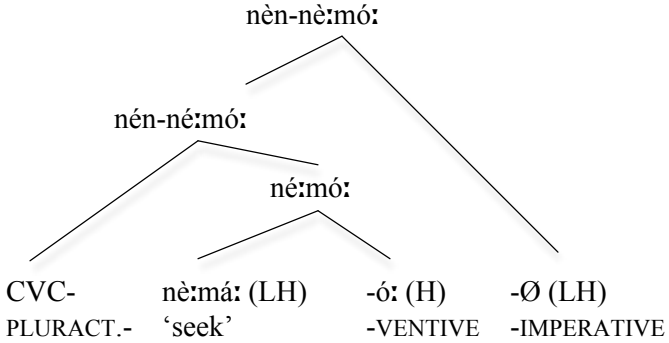
(27) Two tone-replacing cophonologies:



The way two cophonologies in the same word interact depends intrinsically on the hierarchical structure of the word. The outer construction has the last say.

Stratal Optimality Theory: predicts layering (Kiparsky 2000: all opacity results from layering). Problem for Stratal Optimality Theory: not enough layers.

Indexed Constraint Theory: does not predict layering. Interactions between different RM/MCP effects follow from constraint ranking, fixed in the grammar, and not from constituent structure. Recursion is not possible.

Example: Hausa word with two tone-replacing constructions. Ventive inside Imperative. LH imperative melody takes precedence over ventive melody, because Tone-LH_{Imper} » Tone=H_{Vent}:

(28)

	[[nèːmáː -óː]$_{Ventive}$ Ø]$_{Imper.}$	TONE=$LH_{Imper.}$	TONE=H_{Vent}	IDENT
a.	néːmóː	*!	*	*
b.	nèːmóː		*	

- What if the morphology were recursive and the Ventive could occur outside the Imperative? Indexed Constraint theory predicts the same result: LH. Cophonology theory predicts the opposite result: H.
- There are numerous languages in which the same constructions can occur in either order, with different phonological results. Mohanan 1986: two types of compounds in Malayalam can embed inside each other. Turkish: compounding, suffixation can occur in either order (Inkelas and Orgun 1998). Cibemba: derivational suffixes can combine in either order (Hyman 1992, 1994), etc. Indexed Constraint Theory does not capture the overarching generalization that scope is related to hierarchical position.

10 Conclusion

- Cophonology theory has a clear advantage in capturing SUBSTANCE, SCOPE, and LAYERING.
- Concern about cophonology proliferation: without a lid on cophonology variability, a language might vary as much internally as unrelated languages can vary (see e.g. Benua 1997a, b). Two responses (Inkelas and Zoll 2007, Pater 2009). (a) Formal. Anttila (1997, 2002, 2007): cophonologies in a same language conform to a partial master ranking of constraints; only constraints left unranked in this master ranking are allowed to vary in their ranking across individual cophonologies. (b) Substantive. Bermudez-Otero and McMahon (2006): cophonological diversity arises from diachronic change; languages change too slowly and systematically to produce wildly divergent cophonologies.
- **Cophonology theory, Stratal OT** and **Indexed Constraint theory** are already converging; their successor will share the common goal of tying morphologically conditioned phonological effects to morphological subconstituents of complex words.

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