The phonetic roots of phonological typology:
Final syllable vowels

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1. Introduction and agenda: Typology and UG

- Formal models of the phonological component of UG ask two interlocking questions:

  1. Modeling the individual: what is it we think a speaker of a given language knows when we say he or she knows that language?

  2. Modeling the species: what constraints does UG place on the set of "possible languages"?

- How much of the typology of sound patterns must be considered a consequence of the structure of UG, and how much can we explain without resort to hypotheses involving innate, tacit knowledge?

- Current phonological theory (i.e. Optimality Theory – Prince and Smolensky 1993) is committed to a maximalist agenda for the UG derivation of phonological typology. OT Constraints (well-formedness conditions) are universal.

  ☞ 'On this view, Universal Grammar provides not only the formal mechanisms for constructing particular grammars, it also provides the very substance that grammars are built from.' (P & S 1993: 3)

MAXIMALIST ASSUMPTION: Questions 1 and 2 above are the same. UG must generate "all and only" typologically attested (or predicted) sound patterns.[1]

- How much typology is a consequence of UG then? OT answer: as much as possible.

- But is all typology really a consequence of UG? Hyperbolic example: no human language makes contrastive use of sounds whose crucial perceptual cues reside above 20,000 Hz.

  *DOGWHISTLE: Frequencies above 20,000 Hz are marked (?)

- Background questions for this talk: What is the role of phonetic information in creating typological patterns? What is the role of phonetic information in the phonological grammar? By extension, what is the relationship between the grammar and typology?

AGENDA: the Maximalist Assumption should be abandoned.

2. Positional Neutralization (Steriade 1994)

- Certain positions, termed '*strong*' or 'prominent', license the realization of more contrasts than remaining positions, termed '*weak*'.

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[1] In this spirit, in his Plenary Address to the 2002 Annual Meeting of the Linguistic Society of America in San Francisco, "Optimization, Grammar, and Cognition", Paul Smolensky expressed a personal willingness to give over a certain percentage of his genetic code to an optimality-theoretic constraint expressing the universal preference for CV syllables.

2.1. PN in the grammar: two opposing views

(1) POSITIONAL FAITHFULNESS and POSITIONAL MARKEDNESS (Alderete 1995, Beckman 1996, 1998, Crosswhite 2001, Zoll 1997, *inter alia*)

- Phonological strength results from Faithfulness or Markedness constraints parametrized to refer to specific positions.

a	Ident[hi]/σ@	>>	*MidV	>>	Ident[hi]
b	*MidV/unstressed σ	>>	Ident[hi]	>>	*Mid

- PROBLEM: In principle, any feature or marked structure may be paired with any strong or weak position to derive attested patterns. Usually considered a failing of the approach – it overgenerates (see e.g. Smith 2002 for a potential fix).

(2) LICENSING-BY-CUE and DIRECT PHONETICS (Steriade 1997 *et seq.*, Flemming 1995, 1997, 2001, to appear, Kirchner 1998, Zhang 2001)

- Typology reveals that PN patterns are not just arbitrary pairings of strong (or weak) positions with lists of features they can (or can't) realize. Emerging generalizations are explicable in terms of the phonetic characteristics of the positions in question.

- Therefore: a more strongly predictive model of the Grammar would have these phonetic cues themselves, not arbitrarily listed positions, license the realization of contrasts.

- Predicts necessary co-presence of PN patterns and phonetic patterns creating them.

- Must assign "unnatural" or synchronically arbitrary patterns a radically separate grammatical implementation.

2.2. Example: Unstressed Vowel Reduction

- Phonological Vowel Reduction: Stressed syllables license more vocalic contrasts than unstressed syllables (Steriade 1994, Crosswhite 2001, Flemming 2001, Barnes 2002).

(3) Central Eastern Catalan Vowel Inventory (Beckman 1998, Prieto 1992, Recasens 1991)

STRESSED	->	UNSTRESSED
i	->	i
e, ɛ, a	->	ə
u, o, ɔ	->	u

(4)

STRESSED		UNSTRESSED	
r̃íw	'river'	r̃iwét	'river, dim.'
néw	'snow'	nəwétə	'snow, dim.'
mɛ́l̃	'honey'	məlétə	'honey, dim.'
pálə	'shovel'	pəlétə	'shovel, dim.'
r̃ɔ́ðə	'wheel'	r̃uðétə	'wheel, dim.'
mónə	'monkey, fem .	munétə	'monkey, fem. dim.'
kúrə	'cure'	kurétə	'cure, dim.'

- Unstressed vowel reduction is extremely common cross-linguistically.

- A further typological generalization: In vowel reduction systems, vowel height contrasts are the first to go. Frontness/backness contrasts are never singled out to the exclusion of height contrasts.

(5)   Common stressed unstressed mapping:

i	u		i	u
e	o	$\Rightarrow$	ə	
a				

(6)   Non-occurring mapping:

i	u		ɨ
e	o	$\Rightarrow$	ə
a			a

- When vowel height contrasts are lost in unstressed syllables, the vowels to go are almost invariably the mid and low vowels. High vowels stay put.

- Languages with phonological vowel reduction are almost invariably those languages with a stress accent strongly and reliably cued by a difference in vowel duration between stressed and unstressed syllables (Lehiste 1970).

CONNECTION (Barnes 2001, Flemming 2001): Shortening of vowels in unstressed syllables leads to undershoot of more open target articulations of non-high vowels. Raising of these creates a compressed vowel space in which contrasts are likely to be collapsed through reinterpretive sound change.

- Potential Direct Phonetics solution: Replace *low vowel/unstressed syllable with, e.g., *low vowel < 70 ms

2.3. Extension to final syllables

- Direct mention of phonetic duration in the encoding of the typology of vowel reduction also allows extension of the generalization to other environments.

- In many VR systems, unstressed syllables that for whatever reason are typically realized with greater phonetic duration are "exceptions" to the rules of the VR system. Among these exceptional positions are domain-final syllables.

(7)   Catalan dialects (Recasens 1991)

      a   In a number of Catalan dialects the opposition between unstressed word- or phrase-final /a/ and /e/ is maintained, whereas non-finally the distinction is collapsed, both vowels being realized as [´].

      b   Odén (transitional between North-east and Central Eastern Catalan)

		Medial	Absolute final
/a/	->	[´]	[A]
/e/	->	[´]	[e]

- Final lengthening: possibly universal tendency for final material in some domain (utterance, phrase, or word) to be lengthened substantially relative to typical domain-internal realizations of the same category (see e.g. Oller 1973, Klatt 1975, Beckman and Edwards 1987, Wightman et al. 1992, Keating, Wright and Zhang 1999, *inter alia*).

- The Direct Phonetics approach to VR patterns captures the behavior of final syllables as well. Non-phonetically based approaches must see them as arbitrary exceptions.

3. Final syllable vowels: typological characteristics

(a) Final syllable vowels commonly resist reduction and assimilation processes which analogous domain-internal vowels would undergo.[2]

(b) Final syllable vowels are rarely (one good example in my survey: Hausa) the strongest licensers of vowel contrasts in the word. Where they are strong, they are generally strong *alongside,* e.g., vowels in stressed syllables or vowels in other strong positions.

(c) No clear instances in which final syllables allow more contrasts than stressed syllables.

- Possible explanation for (b) and (c): unlike the lengthening of stressed vowels in UVR systems, lengthening of phrase-final syllables does not come at the expense of non-phrase-final vowels. No durational pressure on vowels outside this strong position. Final lengthening exempts vowels from shortening they might otherwise undergo.

(d) In the overwhelming majority of cases, it is only final *open* syllables which display positional strength effects. Vowels in domain-final closed syllables are unaffected.

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[2] See Barnes 2002, Chapter 3, for details. Documented examples include Russian, Belorussian, Ukrainian dialects, Brazilian Portuguese, Eastern Mari, Uyghur, Hausa, Catalan dialects, English, Yakan, Maltese, Nawuri, Shimakonde, Bonggi, and Timugon Murut. See Zhang 2001 for related facts involving the licensing of contour tones.

- Final lengthening has been shown in numerous studies to affect first and foremost domain-final segments (C or V), with decreasing effect on segments farther from the word-boundary.[3]

4. A typological irregularity: Timugon Murut

- Contrary to generalizations (b), (c), and (d) above, evidence for final syllables open and closed as the strongest positions in a system irrespective of the placement of stress has been adduced from the Austronesian language Timugon Murut (Steriade 1994).

4.1. Murut basics (Prentice 1972, Kroeger 1992)

- Timugon dialect of Murut , an Austronesian language of Sabah, Malaysian, on the island of Borneo.

(8)   The vowel system of Timugon Murut

    i   u

                    o

       a

- Stress in TM is fixed on the penultimate syllable.

- Unrestricted contrast of all four vowels in the TM system, however, is available only in the *unstressed* final syllable. Outside the final syllable, the following restrictions apply:

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[3] Pattern (d) rules out general psycholinguistic prominence as an explanation for final syllable PN effects. Studies showing psycholinguistic prominence of final material (e.g. Kehoe and Stoel-Gammon 1997, Curtin 1999) demonstrate that the additional prominence is a property of *the entire final syllable*. Were this the source of final syllable PN effects, we should see them equally for the vowels of final syllables regardless of shape, and on the onset consonants of final syllables as well. Nothing of the sort is attested.

a. All vowel qualities are contrastive in the stressed penult, but [o] is only tolerated there when the final syllable also contains an [o].

b. /o/ and /a/ do not contrast in pretonic syllables. Where the tonic and final are /o/, all contiguous pretonic /o/ or /a/ surface as [o]. Otherwise, they surface as [a].

(9)   Distribution of non-high vowels in Timugon Murut

a.	tanom	'plant'	b.	bolos	'voice'	*bolas
	baloy	'house'		onto	'smell of burnt rice'	*onta
	limog	'dew'		lopot	'wrap up'	*lopat
	iloŋ	'look!'				

(10)   Rounding harmony in Timugon Murut pretonic syllables

a.	orop + an	->	arapan	'perch' (Referent Focus)
	ongoy + an	->	angayan	'go' (RF)
	in + abot + an	->	inabatan	'belt' (RF, past tense)
b.	tanom + in	->	tanamin	'plant' (RF)
	ongoy + in	->	angayin	'go' (Locative Focus)
	sigo + in	->	sigain	'spy on'
c.	tanom + on	->	tonomom	'plant' (Object Focus)
	patoy + on	->	potoyon	'kill' (OF)
	pa + sakoy + on	->	posokoyon	'cause to mount'
	mapa + ongoy	->	mopoongoy	'cause to go'

CONCLUSION: However "strong" stressed syllables are to be considered in TM, it is clear that final syllables must be considered stronger.

4.2. Analysis

- Possibility 1: Generalizations (b), (c), and (d) are "accidental universals". Timugon Murut is not aberrant in any way.

- Possibility 2: Timugon Murut unstressed final syllables have some as yet undescribed phonetic prominence which makes them such a wonderful place for vowel contrasts.

- Possibility 3: Something else is going on here, and typological patterns of positional neutralization are not constrained synchronically by the phonetics.

5. Something else

5.1. Concerning the phonetics of /o/ in NE Borneo

- Timugon Murut /o/ is [o] only before [w]. It is [ɔ] only before velar consonants in closed syllables. Its default pronunciation is something more like [ɵ], what Prentice describes as a "voiced lower-mid central half-rounded vocoid" (Prentice 1971: 19)

- Closely related Dusunic languages have /o/ as "a back unrounded or only slightly rounded vowel, roughly [ɤ], with considerable tensing of the tongue back" (Kroeger 1992: 280). Kroeger even refers to it as "the neutral vowel" in Kimaragang.

CONCLUSION: /o/ in this part of the world has a somewhat "reduced" character – odd for a vowel restricted to only the most prominent position in the language[4].

5.2. Diachrony, and an explanation

- The phonetic facts are actually unsurprising, given that in most cases in the languages in question the historical source of [o] is actually *PAN /ə/ (Robert Blust, p.c.; hereafter *PAN and *Proto-Malayo-Polynesian reconstructions from Blust 1999, 2000, Dusunic Tatana' forms from Pekkanen 1993, Kadazan/Dusun from Miller 1993).

- Due to its short duration and central articulation, schwa is generally among the *least* restricted vowels in the inventories of the languages of the world.

- So what happened?

POINT 1: *PAN [ə] becomes [o] (or rather [ɵ]) in final syllables

(11)   *PAN /ə/ in the Murutic and Dusunic final syllables

*PMP	tanəm	>	TM	tanom	'plant'
*PAN	qaNəb	>	Tatana' aŋob	'door'
*PAN	Sipəs	>	Tatana' lipos	'cockroach'
*PMP	nipən	>	Tatana' dipon	'tooth'

POINT 2: *PAN [ə] becomes [a] in stressed penultimate syllables

- This is what happens to schwa in a true position of prominence: sonority enhancement (Cho 2001) or positional augmentation (Smith 2002).

POINT 3: *PAN [ə] becomes [o] in stressed penultimate syllables *when followed by [o] in the final syllable*.

(12)   *PAN /ə/ in Murutic/Dusunic stressed syllables

a.	*PAN təlu	>		talu	'three'
	*PAN Səpat	>	Kadazan/Dusun apat		'four'
b.	*PMP ənəm	>		onom	'six'
	*PMP dəmdəm	>	Tatana'	rondom	'dark'
	*PAN gəm[5]	>		gomgoŋ	'fist'
	*PMP dəpa	>		lopo	'fathom'

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[4] In fact, a long list of languages actually avoids reduced vowels in final position (see Barnes 2002: 271-273).
[5] From Blust (1988), meaning 'grasp in the fist'.

- Such "support" phenomena, whereby vowels resist changes when neighboring syllables contain identical vowels are well-attested. Presumably the possibility of sustaining a single gesture (here rounding) over two syllables allows for a gesture of greater magnitude (hence resilience diachonically). Essentially the phonetic side of "geminate integrity" effects.

POINT 4: In certain instances, *PAN [a] becomes TM [o] (via [ə]?) in final syllables.

- Essentially the opposite of POINT 2, this might be vowel reduction in a weak syllable.

(13)   *PAN /a/ > [o] in Timugon Murut posttonic syllables

a. /_#	*lima	>	limo	'five'
	*duSa	>	duo	'two'
	*kita	>	kito	'see'
	*tuba	>	tuo	'fish poison'
	*mata	>	mato	'eye'
b. /_j#	*PMP m-atay 'to die'	>	patoy	'die
	*PMP sakay-an 'vehicle, ride in'	>	sakoy	'mount, ride'
c. /_h#	*qumah	>	umo	'cultivated field'

INTERIM SUMMARY: The above produces a system in which [o] only occurs in stressed syllables when it is followed by [o] in the final. Synchronically, this looks like final syllables are strong or prominent. Diachronic analysis, however, make it clear that finals were phonetically *weaker* than stressed syllables.

5.3. Rounding harmony

- In closely related Kimaragang, all pretonic /a/ and /o/ reduce to [ə].

- If this were also true of an earlier stage of Timugon Murut, the leftward spread of rounding from stressed syllable [o] would look like an ordinary form of vowel-to-vowel coarticulation. Schwa often assimilates to neighboring vowels. Later, full vowel quality must have been restored.

(14)   Rounding and Unrounding in Timugon Murut

*tanəm   >   tánom
                        stressed /a/ > [a], final schwa > [o]

*tanəm-in   >   tanámin 'plant' (Referent Focus)
                        stressed */ə/ > [a], pretonic non-high > *[ə] > [a]

*tanəm-ən   >   *tənəmən   >   tonómon 'plant' (Object Focus)
                        stressed */ə/ > [o]/_Co(C)#, pretonic non-high > *[ə] > [o]

- Phonetic prominence hierarchy for Timugon Murut:

stressed syllables   >>   final syllables   >>   pretonic syllables

- Phonological strength hierarchy suggested by synchronic analysis

final syllables   >>   stressed syllables   >>   pretonic syllables

5. Conclusions

QUESTION: Is there any evidence to suggest that from the point of view of synchronic phonology, there is anything wrong with Timugon Murut? Is a system like this harder to learn, less stable over time, or in any other way more costly to maintain than other systems? Absent *positive empirical evidence* that this is so, our assumption should be:

- UG is capable of generating and sustaining systems like that of Timugon Murut, regardless of whether they are phonetically natural or grounded synchronically.

- It follows from this that the typology of positional strength systems cannot be a consequence of constraints on possible grammars imposed by UG. So where does it come from?

- Phonologization: sound change is driven by phonetics, such that sound changes are by definition phonetically natural. "Unnatural" systems can arise through the complex interaction of a set of changes, but are predicted to be uncommon (see e.g. Ohala *passim,* Blevins and Garrett 1998, Blevins, in press, Barnes 2002 for details).

- Typological patterns could of course in theory be, and probably sometimes are, the result of constraints on possible grammars present in UG. This should not, however, be our null hypothesis. Where other, empirically verifiable explanations are possible, they are to be preferred. The Maximalist Assumption should be abandoned.

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