Comparative markedness and containment

Marc van Oostendorp
Meertens Instituut, Royal Netherlands Academy of Arts and Sciences
marc.van.oostendorp@meertens.knaw.nl

Abstract
The theory of 'Comparative Markedness' of McCarthy (forthcoming) is presented; it is shown how it can deal with various famous problems for OT in a rather elegant way. This leads to some reflection on the formalism of the theory. It is pointed out that the theory does not necessarily have to be built on Correspondence Theory; a version within Containment Theory of McCarthy and Prince (1993) is also possible and might actually be preferable in certain ways.

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1. Formalism

Comparative Markedness (CM) is a theory about the structure of (markedness) constraints. The basic proposal is this:

(1) *Comparative Markedness*
There are two versions of every markedness constraint:
1. One version counts 'old' violations, i.e. those violations in a given candidate that were also already present in the Input
2. One version counts 'new' violations, i.e. those violations that were not yet present in the Input.

The 'Input' in (1) can be seen for most practical purposes as the 'input' in the traditional sense; technically, McCarthy uses an actual output candidate (the 'Fully Faithful Candidate' or FFC), which is, roughly, the input, plus the most plausible syllabification assigned to the input. This is of no concern to us here, hence we will stick to the term 'Input' for convenience.
Formally, the paper can be seen furthermore as an extension of an earlier paper my McCarthy, 'Against Gradience' (AG, 2002, also on ROA). In AG, it is proposed that all constraints obey a formal condition:

(2) *Locus Hypothesis*.
∀ constraint C ∀ candidate K
the number of violation marks C assigns to K = the number of loci of violation for C in K.

This disallows constraints such as (classical Alignment), where one foot (=one locus of violation) can generate an unbounded number of violations, depending on the distance to some edge. In CM, the hypothesis is further strengthened by the following condition on loci:

(3) *Strict Locus Hypothesis*
Phonological segments are the only possible loci of violation (for markedness constraints).
∀ constraint C ∀ candidate K
the number of violation marks C assigns to K = the number of segments violating C in K.

This means that no constraint can assign more violation marks to a candidate than there are segments in that candidate. It also means that every constraint is defined by a *locus function*:

(4) *A Locus Function* for a constraint C is a function which takes as its input a candidate and as its output the number of segments which violate that particular constraint.

E.g. (CM, p. 7):

(5) $\text{Loc}_{\text{NOVCDOB}}$ ≡ Return every C, where C is [-sonorant, +voice].
$\text{Loc}_{\text{ONSET}}$ ≡ Return every V, where V is initial in some syllable.
$\text{Loc}_{\text{NO-CODA}}$ ≡ Return every C, where C is final in some syllable.
$\text{Loc}_{\text{PARSE-SYLL}}$ ≡ Return every V, where V is the head of an unfooted syllable.
$\text{Loc}_{\text{FT-BIN}}$ ≡ Return every V, where V is the head of a syllable that is the head of a unary foot.

Combining these two insights we then get CM (again disregarding the issue of the Input/FFC):

(5) ${}_{N}M_i$(cand, Input) ≡ Let Loc_i(cand) = $\{c_1, c_2, c_3, ...\}$ and let Loc_i (Input) = $\{i_i, i_2, i_3, ...\}$. For each c_n that lacks a correspondent among i_m, assign one violation mark.
${}_{O}M_i$(cand, Input) ≡ Let Loc_i(cand) = $\{c_1, c_2, c_3, ...\}$ and let Loc_i (Input) = $\{i_i, i_2, i_3, ...\}$. For each c_n that has a correspondent among i_m, assign one violation mark.

Since every c_n either has or lack a correspondent among i_m, this ${}_{N}M_I \cup {}_{O}M_i = M_i$, the classical markedness constraint (also ${}_{N}M_I \cap {}_{O}M_i = \emptyset$, and $|{}_{N}M_I| + |{}_{O}M_I| \leq S_C$, the number of segments in the candidate; as a matter of fact, if S_I is the number of segments in the input, we also know that ${}_{O}M_i \leq S_I$).
Note that it is possible in principle to formulate constraints against insertion as CM constraints. Take DEP, the constraint against insertion of segments. First formulate the following special locus function:

(6) Lo_{*Struc} ≡ Return every segment.

DEP can now be formulated as ${}_{N}M_{*Struc}$

(7) ${}_{N}M_{*Struc}$(cand, Input) ≡ For each segment in the candidate that lacks a correspondent among the segments in the Input, assign one violation mark.

Other constraints against insertion could be similarly reformulated; interestingly, it is not possible to formulate constraints against deletion in a similar way: this is the irreducible 'core' of faithfulness under this approach.

2. Examples

2.1. Grandfather effects: ${}_{N}M$ » Faith » ${}_{O}M$

'Grandfather effect' is a new term. It described phenomena where 'old' instances of bad segments are surfacing, but new instances are blocked from arising:

(8) a. Voiced obstruent assimilates to following voiceless

/ʔagsam/	ʔaksam	'he swore an oath'
/mazkuːr/	maskuːr	'mentioned'

b. But not vice-versa. Assimilation can't create marked voiced obstruents

/ʔakbar/	ʔakbar, *ʔagbar	'older'

c. Otherwise, voiced obstruents, even codas, are treated faithfully

/ʔibnu/	ʔibnu	'his son'
/dabdaba/	dabdaba	'pitter-pat (footsteps)'

PA is now made opaque by t deletion (schwa deletion is implied to be proceeding the processes described here):

(9)

/ʔagsam/	${}_{N}$NOVDOBS	${}_{N+O}$AGREE(vc)	IDENT(vc)	${}_{O}$NOVDOBS
ʔaksam			*	
ʔagsam		*!		*
/ʔakbar/				
ʔakbar		*		*
ʔagbar	*!		*	*
/ʔibnu/				
ʔibnu				*
ʔipnu			*!	

Note that it is possible in principle to do this with one more specific markedness constraint:

(10) CLUSTER: Return every voiced obstruent immediately before an unvoiced obstruent.

(11)

/ʔagsam/	CLUSTER	IDENT(vc)
ʔaksam		*
ʔagsam	*!	
/ʔakbar/		
ʔakbar		
ʔagbar		*!
/ʔibnu/		
ʔibnu		
ʔipnu		*!

Note. Kager (p.c.) remarks that all examples of grandfather effects McCarthy discusses are amenable to a reanalysis using a conjunction of markedness+markedness constraint; McCarthy discusses local conjunction but not of the M+M type (only M+F and F+F). In particular in this case the admittedly adhoc CLUSTER could be replaced by the following conjunction:

(12) CLUSTER = $\text{NoVcdOb}_{]\sigma} \cap$ AGREE

2.2. Phonologically DEE: $_{N}$M » Faith » $_{O}$M

'DEE' are a well-known problem for OT; they have been analysed by Lubowicz (2002), but in a way which McCarthy argues is unsatisfactory in a number of ways. It can be dealt with in CM. Example: in Makassarese, epenthetic vowels, but not underlying vowels have to be followed by an epenthetic glottal stop:

(13)

a.	/rantas/	rántas*a*ʔ	'dirty'
	/jamal/	jámal*a*ʔ	'naughty'
b.	/lompo/	lómpo	'big'

McCarthy deals with this by splitting FINAL-C ('words should end in a consonant') into an 'old' and a 'new' version:

(4)

/rantas /	$_{N}$FINAL-C	CODACOND	DEP-V	DEP-C	$_{O}$FINAL-C
rantasaʔ			*	*	
rantasa	*!		*		
rantas		*!			
/lompo/					
lompo					*
lompoʔ				*!	

2.2a. Morphologicall y DEE: OO-$_N$M » Faith » $_O$M

In order to be able to analyze morphological DEE, McCarty introduces a different kind of CM constraint: Output-output new markedness (banning the introduction of 'new markedness' vis a vis some new form). Here is an example not discussed by McCarthy. In Turkish vowel harmony (just like in many vowel harmony systems) roots can be disharmonic. Turkish has both roundedness and backness harmony; I concentrate on the latter for reasons of space.

(5) a. *ip* 'rope' *ip-ler* 'ropes' **ip-lar* b. *pul* 'stamp' *pul-lar* 'stamps', **pul-ler*

Yet stems can be disharmonic:

(6) a. *kitap* 'book' b. *kudret* 'power'

This can be seen as a DEE, stems being underived environments and affixed forms being derived environments. Let us assume that vowel harmony is an instance of the markedness constraint SPREAD (Padgett 1995, McCarthy 2002).

(7) SPREAD(F)
Return every segment that is not associated with an F, if F is present in the representation.

We thus need a OO-$_N$SPREAD constraint in this case. This constraint penalizes every segment that does not have F, unless this segment was already unattached to F in the input. Ranking this constraint above IDENTITY-constraints, and ranking IO-$_O$SPREAD below them, gives the right results:

(8)

ip+lar	OO-$_N$SPREAD	Identity	IO-$_O$SPREAD
☞ipler		*	
iplar	*!		

(9)

kitap	OO-$_N$SPREAD	IDENTITY	IO-$_O$SPREAD
☞kitap			*
kitep		*!	

2.3. Non-iterating processes: $_O$M » Faith » $_N$M

There are many phonological processes which apply only once; this in itself is mysterious given the basic tenets of classical OT. Not so under CM.
Lardil example: /pulumunitami/ > pulimunita (not *pulimuni, *pulimu, *puli).

(10)

pulimunitami	$_O$FINAL-C	MAX	$_N$FINAL-C
☞pulimunita		**	*
pulimun		*****!	
pulumunitami	*!		

2.4. Counter-feeding opacity: $_{O}$M » Faith » $_{N}$M

Opacity has been the topic of quite a lot of study within OT in recent years. It turns out that CM can handle a significant subset of cases; this is interesting since the theory obviously was not specifically designed for such cases.
Barrow Inupiaq example:

(11) a. *Palatalisation after /i/*

Stem	*-lla* 'be able'	
/niʀi/	niʀiʎʎa	'eat'
cf. /sisu/	sisulla	’slide’

b. *No palatalisation after /ɨ/*

/tiŋɨ/	tiŋilla	

Note by the way, that in order for this to work, we need to assume that the Input (the 'FFC') needs to have the affixes put in the right position already.

(12)

/niʀi lla/	$_{O}$PALATALIZE	IDENT(PLACE)	$_{N}$PALATALIZE
niʀilla	*!		
☞ niʀiʎʎa		*	
/tiŋɨ lla/			
tiŋilla			*
tiŋɨʎʎa		*!	

Notice that this assumes that the 'input' (formally, the FFC) should already have established that the suffix is added after the stem.

3. Remarks

3.1. On formalism

CM is presented here in terms of Correspondence Theory. Although this may be a natural choice from the point of view of present-day theorising, it is not the only possible option. CM could also have been presented within Containment Theory of classical OT (Prince and Smolensky 1993). As a matter of fact, McC notes that the analysis of Lardil in Prince and Smolensky is a way of dealing with this facts which just happens to be no longer available under Correspondence Theory.
Containment is formulated in McCarthy and Prince (1993) as follows:

(18) *Containment*.
No element may be literally removed from the input form. The input is thus contained in every candidate form.

A containment model is purely monostratal: all constraints only look at one representation, and there is thus no qualitative distinction between input and output. What we need for CM to be implemented, is a way to distinguish beteen 'new' and 'old'

structure. In P&S this is accomplished partly by leaving unparsed 'old' structure floating (it is safe to assume that floating material will never be old) and partly by giving epenthetic segments a special structure (they are left empty of feature content).
This is not sufficient for the purposes of CM, however, because many new and old elements will simply be integrated in the structure and it will be no longer clear whether that structure is old or new. We would need a containment model in which every element has its status as 'old'/'new' on its sleeves: old material has a different colour from new material. Technically, we could give every element in the phonological representation a subscript 'o' or 'n' denoting its status. Constraints which can 'see' the morphological affiliation of every segment have actually been proposed in the literature. One example is a constraint which occurs under various names in the literature, but which I will call here EXPRESSMORPHEME:

(19) EXPRESSMORPHEME
Every morpheme in the input has to find some expression in the output.

In that case we could reformulate 'new' comparative markedness constraints as markedness violations which involve new material (new segments or segments dominating new features) and 'old' comparative markedness as violations in wich no new material is involved. As in the case of correspondence-based CM, these two types of constraint would divide between them all the violations of 'traditional' markedness constraint. This move would have to confront several technical problems, because it would not be as deeply embedded within the vast literature on correspondence effects we have, but the point is that such a move would indeed be possible: CM is thus to a large extent independent of Correspondence Theory; P&S could have been extended to accommodate it, if necessary, as well.

3.1. On morphologically derived environment effects

Let us return to Turkish vowel harmony. One (maybe smaller) problem with a (correspondence-based) CM approach is that also *phonologically* derived environments obligatorily undergo harmony:

(20) /hükm/ > hüküm 'judgment'
/metn/ > metin 'text'

We can account for this by CM:

(21)

hükm	IO-$_N$SPREAD	IDENTITY	IO-$_O$SPREAD
☞ hüküm		*	
hükım	*!		

The problem is — this is a new constraint: morphologically and phonologically derived environments are treated separately in CM; the convergence of the two in Turkish could be a coincidence; but that is not what a survey of the literature suggests.

A more severe problem is that some quite unlikely scenarios are predicted: assume a hypothetical language L with roundness harmony, a stem *bobin*, and a suffix *-i*. Given high-ranking OO-$_0$SPREAD (and low-ranking other SPREAD constraints) we would have:

- Underived form: *kitap* (OO-$_0$SPREAD not applicable).
- Derived form *kitep-lar* (OO-$_0$SPREAD applies to stem element, but not to suffixes).

I am not aware of any language that has this type of harmony, and, intuitively, it seems quite absurd. OO-$_0$CM has more of these strange 'anti-cyclic' consequences, where things happen only to forms once they are fully embedded in other forms (without the shape of the outer material being relevant).
Another analysis is available for the disharmony within roots, one based on positional faithfulness: a constraint IDENTROOT could also account for the differences between underived and derived forms:

(22)

ip+lar	IDENTROOT	SPREAD	IDENT
☞ipler			*
iplar		*!	

(23)

kitap	IDENTROOT	SPREAD	IDENT
☞kitap		*	
kitep	*!		*

Furthermore, this constraint could easily deal with phonologically derived environment effects as well, if we assume (quite naturally) that epenthetic vowels are not part of the root (a morphological category), hence not sensitive to the effects of IDENTROOT.

(24)

hükm	IDENTROOT	SPREAD	IDENT
☞hüküm			
hükım		*!	

Clearly, IDENTROOT also does not have the undesired byeffect of predicting anti-cyclicity, and from this perspective, it thus seems to be a more accurate theory of disharmony as a MDEE. We could now wonder what the formal properties of this IDENTROOT constraint actually are. It could be formulated as follows:

(25) IDENTROOT
Return every segment *s* that is part of the root, and which is non-identical with respect to feature F to segment *s'* in the input, where *s* and *s'* are in a correspondence relation.

Crucial here is the phrase 'part of the root'. In order for this to work we need to be able to distinguish between those segments in a give form which are part of a specific morpheme and those which are not. The only way I see to actually make this work is by exactly the same kind of 'colouring' of material that was argued above to be necessary for a containment version of CM:

(26) IDENTROOT
Return every root segment which is connected to a feature outside the root (or connected to a root feature by an association line which is not part of the root).

Effectively, this comes very close to CM in a containment style: no reference to an independent input representation is needed any more. Notice further that it seems possible to formulate this type of CM within a segmental version of the Strong Locus Hypothesis. Further note that McCarthy uses IDENTROOT independently of CM in his analysis of Warlpiri harmony (p.14)