Markedness in I-language

Ricardo Bermúdez-Otero

This paper summarizes material presented in
Bermúdez-Otero & Börjars (forthcoming: §2, §6, §7, and §8);
see bibliography below.

AIMS

(1) The basic problem:

Optimality-theoretic markedness constraints are *grounded*, i.e. they appear to be *functionally adapted* to the requirements of performance.

(2) Against this background, the paper aims to:

- clarify the status and origin of markedness constraints qua *I-language entities*;
- refute the charge of *'substance abuse'* against OT (Hale & Reiss 2000), according to which the inclusion of markedness statements in grammars violates Ockham's Razor.

(3) To this end, the paper will argue that:

- if grammars were acquired by mere inductive generalization over corpora of utterances subject to performance bias, they would not consistently respect the typological generalizations embodied in markedness constraints;
- markedness constraints enable infants to *transcend the limitations of induction* over primary linguistic data;
- the grounded character of markedness constraints can be explained by assuming that they are *not innate*, but emerge through a developmental process where *self-monitoring of the learner's own performance* plays a key rôle.

THE PROBLEM OF GROUNDING

Markedness constraints are not arbitrary

(4) An example (see Itô 1989, Kager 1999: 131, McCarthy 2002: 145):

> CODACOND-Place
> Assign one violation mark for every C-Place node that is exhaustively dominated by rhymal segments.

In OT, this constraint is unambiguously conceived of as an *I-language entity*:

- it is part of a *computational system* embodying the speaker's knowledge of phonology;
- it refers to *cognitive, specifically linguistic categories* such as features and syllables, rather than to extralinguistic phonetic entities such as articulatory gestures or acoustic spectra (*'self-containment'*; see Croft 1995).

(5) However, CODACOND-Place is *functionally adapted* to the requirements of phonetic performance (see e.g. Myers 1997: §2.1):

- The phonetic cues to a consonant's place of articulation are relatively difficult to discriminate if the consonant is unreleased (≈not followed by a more open articulation).
- In the coda, consonants are typically unreleased.
- CODACOND-Place neutralizes phonological place contrasts in environments where the phonetic realization of contrast is relatively problematic.

'Substance abuse'

(6) Key claims of the critics of OT:

- *Typology*
  Markedness generalizations, understood as typological observations, are mere epiphenomena of recurrent processes of performance-driven change.
- *Acquisition*
  Linguistic patterns governed by markedness do not raise Plato's Problem, i.e. are not subject to poverty of the stimulus.
- Therefore, it is unnecessary to include statements of markedness (such as optimality-theoretic constraints) in the theory of grammar.

See e.g. Hale (2000), Hale & Reiss (2000), Haspelmath (1999), McMahon (2000), Newmeyer (2002), and Reiss (2000).

(7) *Typology and diachrony*

- Typological observation:
  In every language, the onset supports no fewer place contrasts than the coda.
- Diachronic explanation:
  (i) the perceptual cues to consonantal place are less reliable for codas than for onsets (see (5) above);
  (ii) codas are subject to higher misperception rates in performance than onsets;
  (iii) diachronic processes of phonologization driven by misperception are more likely to cause place neutralization in codas than in onsets.
- Implication:
  CODACOND-Place is unnecessary.

(8) *Induction: Hale's (2000: 250ff.)* homo collitumens *thought experiment*

- VOICED OBSTRUENT PROHIBITION (VOP; see e.g. Kager 1999: 40)
  Assign one violation mark for every voiced obstruent.

  (i) grounded on aerodynamic difficulties (see (11) below);
  (ii) plays a crucial role in the optimality-theoretic analysis of languages such as German (no voiced obstruent in the coda) and Hawaiian (no voiced obstruents at all).

- *Homo collitumens*: a hypothetical genetically mutant human creature
  (i) lacking an (innate) representation of VOP,
  (ii) possessing a pharyngeal cavity enclosed by an expandable membrane which removes the aerodynamic difficulties attendant on obstruent voicing.
- Would *homo collitumens* infants be able to acquire German or Hawaiian?

  Hale's answer: Yes, by induction over input data.

  Implication: the generalizations for which VOP is responsible in an OT analysis are not subject to poverty of the stimulus; from the viewpoint of acquisition, the constraint is unnecessary.

Challenges for OT

(9) To save markedness constraints from Ockham's Razor, the proponents of OT must:

- specify the ways in which the typological patterns that arise from constraint interaction differ from those that would emerge from mere performance-driven change under a heavily inductive model of acquisition;
- identify items of phonological knowledge that cannot be acquired by purely inductive means without access to markedness constraints.

(10) In addition, it would be desirable to clarify the origin of markedness constraints, explaining how they come to be grounded.

DIFFICULTY LANDSCAPES VS MARKEDNESS CONSTRAINTS

Performance difficulty in voiced obstruents

(11) Vocal fold vibration is difficult to maintain if egressive pulmonic airflow is restricted supraglotally (Ohala 1983, Westbury & Keating 1986).

The difficulty increases
(i) the longer the supraglottal constriction is held,
(ii) the farther back in the oral cavity the constriction is located.

[I assume a concept of relative performance difficulty that can be operationalized in terms of statistical rates of successful production and recognition in an experimental setting.]

(12) *A performance difficulty landscape for voiced plosives*

b	d	g
b:	d:	g:

↓

→

- within any column, the top segment is easier than the bottom segment;
- within any row, segments on the left are easier than those on the right.

(13) *Deriving markedness hierarchies from performance difficulty landscapes*

If we establish a performance difficulty threshold *t* immediately below [d], we obtain two possible partitions of the segment set:

(a) if closure location contributes more to overall difficulty than closure duration,
(b) if closure duration contributes more to overall difficulty than closure location.

a.

	t	
b	d	g
b:	d:	g:

b.

	t	
b	d	g
b:	d:	g:

Predicted markedness hierarchies:

(a) { b, d, b: } ≻ { g, d:, g: } × impossible (unnatural classes)
(b) { b, d } ≻ { g, b:, d:, g: } ✓

(14) *An argument against the 'substance abuse' charge*

Markedness constraints cannot be mere epiphenomena of performance difficulty landscapes because the latter define *phonologically arbitrary classes*.

Another example:

{ [+nas]‿b, [+nas]‿d, [+nas]‿g } ≻ **[+son, –nas]‿b ≻ [+son, –nas]‿d ≻ #‿b > #‿d ≻ [+son, –nas]‿g ≻ #‿g** ≻ [–son]‿b ≻ [–son]‿d ≻ [–son]‿g

(Hayes 1999:§6.2, based on a vocal tract model in Keating 1984.)

Difficulty landscapes vs markedness constraints in OT

(15) *Self-containment*

Constraints are formulated in terms of specifically linguistic categories (see (4) above). In phonology, therefore, markedness constraints refer to *distinctive features*, which pick out *natural classes*, rather than phonetically defined segment lists.

(16) *Simplicity*

Markedness constraints consist of relatively simple statements and cannot therefore reproduce the full complexity of phonetic effects.

E.g. constraints driving coronalization (Cole & Iskarous 2001):

$\_\_V_{[-bk]} \rightarrow$ Cor ✓

$V_{[-bk]}\_\_ \rightarrow$ Cor ✓

$V_{[-bk]}\_\_V_{[-bk]} \rightarrow$ Cor × (unattested)

…even though, phonetically, the rate of misperception of labials and dorsals as coronals is highest when they are flanked by front vowels on both sides.

(17) *Ranking*

Constraints do not interact additively, but are subject to *language-specific relationships of strict dominance*. For this reason, grammars do not reflect the *cumulative effects and trade-offs* between sources of difficulty in performance (see e.g. Hayes 1999: §6.2).

PERFORMANCE ENVIRONMENTS VS STRUCTURAL POSITIONS

Self-containment again

(18) Linguistic markedness → I-language categories

⇳ (no consistent correspondence)

Performance difficulty → E-language entities

E.g. the syllable (Ladefoged & Maddieson 1996: 281-2)

> […W]hat, from a phonetic point of view, do we mean by syllabic? There is no phonetic parameter that can be used to define syllabicity […] The best we can do is to suggest that syllables are 'necessary units in the organization and production of utterances' […] This is a neurophysiological, or cognitive view of the syllable, making the syllable a phonological rather than a phonetic unit.

⇨ CODACOND-Place cannot be reduced to —or deduced from— any collection of statements about phonetics because it refers to an entity, the syllable coda, which neither is phonetic nor can be defined in phonetic terms.

'Aspiration' in Spanish (Gerfen 2001)

(19) [–son] → [ʰ] / __ σ] Driven by CODACOND-Place

apto	[aʰ.to]	'apt'
acción	[aʰ.θjon]	'action'
eslavo	[eʰ.la.βo]	'Slavic'
obtuso	[oʰ.tu.so]	'obtuse'

(20) Can the relevant markedness constraint be reformulated in terms of properties of the phonetic environment, rather than syllabic positions?

- Absence of release cues provided by a 'right-hand modal sonorant context' (Steriade 1997: 94)?

  No, cf. *eslavo* [eʰ.**l**a.βo]

- …But the acoustic transitions in homorganic clusters provide impoverished phonetic cues.

  Not a solution:

/tl/ → [tl]	if tautosyllabified	e.g. *atleta* [a.tle.ta]	(e.g. Mexican Spanish)
/tl/ → [ʰl]	if heterosyllabified	e.g. *atleta* [aʰ.le.ta]	(other aspirating dialects)

Catalan devoicing (Wetzels & Mascaró 2001: note 21)

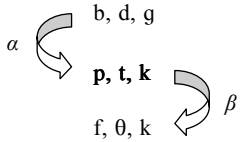
(21) Voicing of stops in stop + liquid clusters

- if tautosyllabic (stop in onset), voicing contrastive: [sem.**p**rə] vs [sem.**b**rə]
  'always' 'sow.3SG.PRES'
- if heterosyllabic (stop in coda), voicing predictable: [su**b**.ru.ti.nə], but *[-**p**.r-]
  'subroutine'

MARKEDNESS CONSTRAINS PERFORMANCE-DRIVEN CHANGE

Global restrictions on phonological systems

(22) *Grimm's Law*



The change abides by a global restriction requiring that all languages should have plain voiceless stops (*α*), even though plain voiceless stops are removed locally (*β*).

(23) *Phonologization and global restrictions*

According to standard models (e.g. Ohala 1989, 1992, 1993), phonologization is driven by misperception, which is in turn caused by the *inherent ambiguity of local phonetic data*:

e.g. • excessively noisy stop release ⇨ affrication
• undershoot during oral closure ⇨ spirantization

But, if phonologization is driven by local phonetic properties, how come it respects global restrictions? (Jakobson 1929, Kiparsky 1995)

(24) *The universal constraint set imposes global restrictions on phonological systems*

CON includes constraints against

- voiced obstruents (VOP)
- fricatives (*[–son, +cont])

but not against plain voiceless stops.

Accordingly, given Richness of the Base, all possible grammars generate plain voiceless stops, regardless of the ranking of constraints.

MARKEDNESS CONSTRAINS GRAMMATICAL RESTRUCTURING

Is rule inversion arbitrary?

(25) According to the critics of OT, markedness is an epiphenomenon of externally driven change; see (6) and (7) above.

⇨ *Internally driven changes* (e.g. restructuring) are predicted to produce *arbitrary results* capable of violating markedness generalizations.

(26) *A test case: rule inversion*

	Stage I	*Stage II*
input	α	β
output	$[\alpha]_A$ $[\beta]_B$	$[\alpha]_A$ $[\beta]_B$
derivation	$\alpha \rightarrow \beta$ / $[\_\_]_B$	$\beta \rightarrow \alpha$ / $[\_\_]_A$

Inverted rules are claimed to be arbitrary: e.g. English intrusive *r* (e.g. Vennemann 1972, Blevins 1997, Halle & Idsardi 1997, Hale & Reiss 2000, McMahon 2000).

Intrusive *l* in the Northeast of the USA (Gick 1999)

(27) Linking *l*

	a. *draw*	a. *drawing*	b. *drawl*	b. *drawling*
UR	/dɹɔː/	/dɹɔː-ɪŋ/	/dɹɔːl/	/dɹɔːl-ɪŋ/
SR	[dɹɔː]	[dɹɔːɹɪŋ]	[dɹɔː]	[dɹɔːlɪŋ]

(28) Intrusive *l*

	a. *draw*	a. *drawing*	b. *drawl*	b. *drawling*
UR	/dɹɔː/	/dɹɔː-ɪŋ/	/dɹɔː/	/dɹɔː-ɪŋ/
SR	[dɹɔː]	[dɹɔːlɪŋ]	[dɹɔː]	[dɹɔːlɪŋ]

(29) Problem: [l]~Ø alternations underwent reanalysis after /ɔː/, but not after other vowels, including /ɑː/ and /ə/.

- Linking *l* after /ə/

	cruel	*cruel act*
UR	/kɹuːəl/	/kɹuːəl ækt/
SR	[kɹuːwə]	[kɹuːwəlækt]

- Failure of *l*-intrusion after /ɑː/ and /ə/

law[l]*-abiding* but *the bra*[Ø] *is*

(30) Solution:

- Laterals are relatively marked, and hence *dispreferred as epenthetic segments*: *[lateral].
- In the dialects under consideration, however, /l/ and /ɔː/ have *identical V-Place specifications* (Gick, Kang & Whalen 2002). After /ɔː/, therefore, it was possible to reanalyse linking [l] as an epenthetic hiatus-breaker that gets its V-Place features by *spreading from the preceding nucleus*, avoiding violations of DEP-VPlace.
- After /ɑː/ and /ə/, in contrast, [l]-epenthesis would violate *[lateral] with no compensating gain in terms of faithfulness. The reanalysis of linking [l] after these vowels was therefore *blocked*

(31) *The law*[l] *is*, but *the bra*[Ø] *is*

		*G[−hi]	DEP-VPlace	DEP-[−son]	ONSET	DEP-CPlace	*[lateral]
/lɔː ɪz/	lɔː.ɻɪz	*!					
	lɔː.wɪz		*!				
	lɔː.ʔɪz			*!			
	lɔː.ɪz				*!		
	lɔː.lɪz ☜					*	*
/bɹɑː ɪz/	bɹɑː.ɻɪz	*!					
	bɹɑː.wɪz		*!				
	bɹɑː.ʔɪz			*!			
	bɹɑː.ɪz ☜				*		
	bɹɑː.lɪz		*!			*	*

(32) On the surface, linking-*l* alternations after /ɔː/ are identical with linking-*l* alternations after /ɑː/ and /ə/. By treating them differently, therefore, children *transcended the limitations of inductive generalization*. They were able to do so through the expectation that an epenthetic segment will be either inherently unmarked or maximally faithful.

THE ORIGIN OF MARKEDNESS CONSTRAINTS

Problems with innateness

(33) Could an innate CON have arisen through *exaptation* (a 'spandrel'; Gould & Lewontin 1979)?

Unlikely:
- too rich and specific
- spandrels typically depart from optimal design

• what's the original adaptation?

(34) Could an innate CON have arisen through *adaptation*?

Unlikely: • for speakers of CVC language, what is the advantage of being innately endowed with constraints on the composition of complex onsets? (Hayes 1999: §13)

An alternative account (Boersma to appear)

(35) The learner posits a high-ranking markedness constraint M against grammatical output representations containing a structure *s* whenever *s* fails to be successfully interpreted by an appropriate performance system.

E.g. acquisition of heterorganic N.C clusters (Russian)

1) The child is exposed to target forms such as [a**ng**lijə] 'England'.

2) Target forms stored in child's protolexicon: /a**ng**lijə/.

3) Child lacks motor control skills to realize target: produces *[a**ŋg**lijə].

4) Response:
- child inserts CODACOND-Place at the top of her proto-hierarchy
- further articulatory experimentation

5) Child masters production of heterorganic N.C clusters:
- target becomes interpretable
- CODACOND-place demoted below IDENT-Place.

(36) Implications:

- Constraints *emerge* in the course of *development*.
- The child transcends the limitations of induction over input data by *accessing her own experience of performance*.
- Rapprochement with *neuroconstructivism* (Karmiloff-Smith 1998).

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CONTACT DETAILS

Ricardo Bermúdez-Otero

R.Bermudez-Otero@ncl.ac.uk
http://www.staff.ncl.ac.uk/r.bermudez-otero/

School of English Literature, Language, and Linguistics
University of Newcastle
Newcastle upon Tyne NE1 7RU
England