Plato's Problem and innate endowments in phonology

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AIMS

(1) This paper aims to respond to a number of *conceptual arguments* levelled against mainstream versions of Optimality Theory (OT) by critics in the *extreme formalist* and *extreme functionalist* camps.

To this end, the paper will argue that:

- adult phonological competence raises *Plato's Problem* in the specific sense that the child cannot acquire such competence only by *mere induction over phonetic data from adult speech*;
- consequently, the *representations* and *constraints* postulated in mainstream versions of OT are needed to account for the ways in which *adult phonological competence departs from an inductive baseline*.

(2) Nonetheless, the paper will suggest that:

- it is unnecessary —and, in fact, problematic— to assume that the full grammatical apparatus of mainstream OT is supplied *innately* to the child by UG;
- some key elements of phonological competence can be acquired by the child through *constructive processes* relying on:
  (i) domain-relevant (but not domain-specific) cognitive predispositions,
  (ii) self-monitoring during performance.

RADICAL CRITIQUES OF MAINSTREAM OT

The typological method

(3) Radical formalists often criticize the importance that OT attaches to typological data in the framing and testing of hypotheses:

- *Using typology to frame hypotheses*

  Typological observation: If a language has B, then it also has A.
  Hypothesis: There is a universal violable markedness constraint *B.

- *Using typology to test hypotheses*

  Factorial typology: *B is a genuine markedness constraint if, given a universal set of constraints CON = $\{C_1, C_2, \ldots, C_n\}$ such that *B ∈ CON, the ranking permutations of CON define all possible human languages and no impossible human language.

See Hale (2003), Hale & Reiss (2000), and Newmeyer (1998). Also relevant here is the distinction between 'generic' and 'naturalistic' conceptions of UG drawn in Burton-Roberts (2000) and Carr (2000).

(4)
> One of the most compelling features of OT, in my view, is the way in which it unites description of individual languages with explanation of language typology. […T]his is arguably the central research problem of phonology and of linguistic theory in general […]
>
> McCarthy (2002: 1)

Grounding

(5) Radical formalists also criticize OT for postulating *externally grounded* grammatical entities.

E.g. CODACOND-Place (Kager 1999: 131, McCarthy 2002: 145; see Itô 1989)
Assign one violation mark for every C-Place node that is exhaustively dominated by rhymal segments.

CODACOND-Place is an *I-language entity* because:

- it is part of a *computational system* embodying the speaker's phonological competence;
- it refers to cognitive, *specifically linguistic categories* (e.g. feature-geometric nodes, syllabic positions) rather than to extragrammatical phonetic entities (e.g. articulatory gestures, acoustic spectra); see Croft (1995) on 'self-containment'.

CODACOND-Place is *functionally adapted* to phonetic performance because:

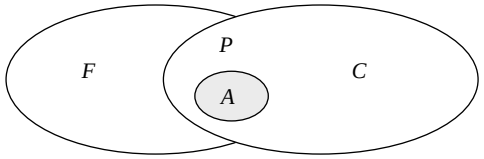
- phonetic cues to consonantal place are relatively poor in unreleased positions;
- coda consonants are typically unreleased;
- therefore, the constraint enforces phonological neutralization in environments where contrast is difficult to implement phonetically.

For the concept of 'grounding', see e.g. Archangeli & Pulleyblank (1994) or Myers (1997). Formalist arguments against grounding are formulated in Hale (2000), Hale & Reiss (2000), Newmeyer (2002), Reiss (2000). For counterarguments, see Bermúdez-Otero & Börjars (forthcoming).

Radically formalist arguments

(6) *Defining the object of study*

- F = the set of all *phonetically (≈functionally) viable* phonological systems
  where, roughly, a phonological system is phonetically viable if it can be acquired and used given the facts of articulation, acoustics, and audition.
- C = the set of all *computationally viable* phonological systems
  where, roughly, a phonological system is computationally viable if it can be acquired and used given the cognitive makeup of human beings (at birth).
- P = the set of all *attestable (≈possible)* phonological systems
  $P = F \cap C$
- A = the set of all *attested* phonological systems
  $A \subset P$



☞ The goal of phonology is to characterize *C*.
☞ Phonology need not —in fact, *must not*— account for those properties of possible phonological systems that are a consequence of their membership of *F*.

(7) *Methodological prescription (I): Downgrade typology!*

A good deal of work in OT assumes *A* to be a representative sample of *P* and attempts to *match P* by means of the factorial typology technique. Radical formalists claim that such attempts are misguided and doomed to failure:

- *Unnatural phonological processes*

  Diachronic processes of *grammatical restructuring* (e.g. *rule inversion*, *rule telescoping*) are claimed to create phonetically unnatural phonological processes. Any phonological theory that incorporates phonetically grounded constraints on attestable phonological systems is bound, incorrectly, to exclude such processes.

  See e.g. Hale & Reiss (2000), McMahon (2000a, b), Hyman (2001). Cf. Bermúdez-Otero & Hogg (forthcoming: §1,2), Bermúdez-Otero & Börjars (forthcoming: §5.3, §6.5).

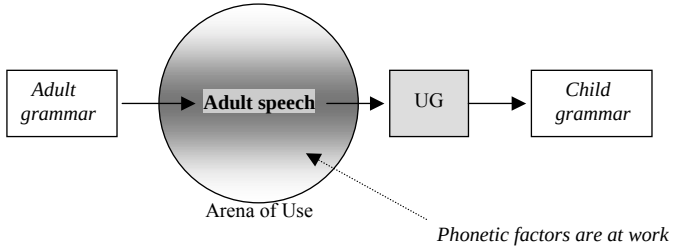
- *Gaps in factorial typology*

  From a computational viewpoint, phonetic constraints on possible phonological systems are arbitrary. Accordingly, any sufficiently general theory of phonological computation is bound to allow systems that are *formally fine, but phonetically nonviable*; these show up as *arbitrary gaps in factorial typology*.

  See e.g. Myers (2002). There is also relevant discussion in Pulleyblank & Turkel (1996).

(8) *Methodological prescription (II): Use Ockham's Razor aggresively!*

Phonetics and the 'diachronic filter' (Hale 2003):



Assumption: Phonetically natural, 'grounded' patterns enter grammars during language acquisition through the *phonologization of performance-related perturbations* of data from adult speech (*hypocorrection*, *hypercorrection*; Ohala 1990, 1992, 1993).

Prescription: • Attribute all grounded phonological patterns to phonologization.
• Excise all grounded elements from phonological theory.

(9) The more we know about the workings of the 'diachronic filter', the more we can protect ourselves against the danger of falsely generalizing from accidental distributional properties of attested languages to the computational linguistic capacity of humans.

Hale (2003: §27)

The radicals' unholy alliance

(10) The outcome of the ultraformalist argument is the claim that *the elements of phonological theory must be strictly arbitrary* (Hale & Reiss's 2000 'Neo-Saussureanism').

Here, radical functionalists agree, though for different reasons. Their hope is that, once natural phonological patterns have been derived from phonetic facts, there will be *nothing left for an autonomous formal phonology to explain*:

(11) Derive language from non-language!

Lindblom, quoted in Myers (1997: 147)

Responding to the radicals' critique of mainstream OT

(12) *Implications of the formalist critique*:

The formalist critique of mainstream OT bites if, and only if, phonological computation is subject to principles that are
- completely *arbitrary* in relation to functional demands,
- deep or *abstract* enough to be masked by typological data,
- *stringent* enough to cause gross departures from naturalness.

⇒ It presupposes the *existence of UG*, understood as an innate, arbitrary, specifically linguistic faculty, independent of other cognitive capacities (*strong nativism*).

(13) *Implications of the functionalist critique*:

The functionalist critique of mainstream OT bites if, and only if, phonological knowledge can be derived from phonetic facts through *cognitive processes that are fully general, domain-independent, and ultimately trivial*.

⇒ It presupposes *strong empiricism*: phonetics imposes structure upon phonology directly.

(14) *Neuroconstructivism: a home for mainstream OT phonology?*

Suppose that phonological knowledge is *grounded on phonetic facts* but emerges during development through a *complex constructive process* modulated by *domain-relevant cognitive predispositions* and involving the *learner's active involvement* (e.g. through performance self-monitoring).

⇒ Then one would expect the following to be the case:
- the elements of phonological competence are *grounded on, but irreducible to,* phonetic facts;

- typological generalizations are *close to, but not a perfect match for*, phonetic naturalness.

For the nativism/empiricism/neuroconstructivism trichotomy, see e.g. Karmiloff-Smith (1998).

(15) *Denting Ockham's Razor*

General strategy:

1) show that mature speakers could not have the phonological knowledge they do in fact posses unless they had access to the representations and constraints postulated in the theory;
2) mitigate the redundancy problem by identifying the processes whereby representations and constraints emerge from, and become dissociated from, their phonetic grounding.

PLATO'S PROBLEM IN PHONOLOGY

Formulating Plato's Problem

(16) *An unhelpful way of formulating the problem*:

- Mature speakers possess grammars that contain highly abstract rules and representations.
- The triggering experience provides no direct evidence for such rules and representations.
- Therefore, the relevant rules and representations are innate.

Problems:

1) *Petitio principii*: this formulation of the argument begs the question by assuming highly abstract rules and representations in the first place.
2) *False dichotomy*: there are more conceivable sources of linguistic knowledge than just induction or innateness.

See Anderson (forthcoming: §2), Bermúdez-Otero & Börjars (forthcoming: §6-§8).

(17) *A different way of going about it*:

- Define a *baseline* (or null hypothesis): What would a *minimally specified learner* know, given exposure to the evidence?
- Attribute *particular rules or representations* to speakers only insofar as this required to describe how their *knowledge departs from the baseline*.
- Then ask the question: what a*dditional specifications should be added to the baseline learner* in order to acquire these rules and representations.

(18) *Defining the baseline: a pure inductive learner*

Why 'pure induction'?

- Because it *minimizes the specifications of the learner* and *maximizes the rôle of redundancies/structure in the data*.

- Because we understand it *mathematically* and have a fair idea of how to model it *computationally* and *neurologically*: Hebbian learning, neural networks, etc. (Hebb 1949).
- Bacause it makes clear predictions:

  e.g. For a purely inductive learner, the acceptability of a string is directly proportional to its frequency.

NB Neural networks can respond nonlinearly to properties of the input (Elman *et al.* 1996). Nonlinear responses, however, are more likely in networks prespecified with a complex layer structure. In the limit, it is not clear whether the network is not in fact simply implementing a symbolic rule (see e.g. Marcus 2001).

Phonological representations vs inductive generalization

(19) *Can phonotactic acceptability be reduced to relative lexical frequency?*

English strings with low lexical frequency and high acceptability: e.g.

-ev#	*rev* (early 20C; truncation of *revolution*); *Kev*, *Bev* (hypocorisms)
-ɔ:g#	*morgue* (19C), *cyborg* (mid 20C; blend of *cybernetic* and *organism*)
#skl-	*sclerosis*; *sclaff, sklent* (dialectal)

Why is #skl- highly acceptable, despite its low lexical frequency?

- Possible answer: both #sk-, #kl-, and #skr- are frequent.
- Problem: both -ɜ:m#, -mp#, and -ɜ:nt# are OK, so why not *-ɜ:mp#?

Implications:

☞ Lexical frequency is not enough; *syllable structure is needed to define the domain of phonotactic constraints.*
☞ A pure inductive learner, without access to prosodic representations, cannot properly *distinguish between phonotactic constraints and accidental lexical gaps*.

On phonotactic acceptability and lexical frequency, see e.g. Coleman & Pierrehumbert (1997), Frisch et al. (2000), Treiman et al (2000). See Pierrehumbert (2003) for a hybrid model combining exemplar clouds with phonological parses.

Markedness constraints vs inductive generalization

(20) According to the critics of OT, markedness is an epiphenomenon of externally driven change; see (8) above.

⇨ *Internally driven changes* (e.g. restructuring) are predicted to produce *arbitrary results* capable of violating markedness generalizations; see (7) above.

(21) *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***)**

(22) Linking *l*

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

(23) Intrusive *l*

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

(24) 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	[kɹuː.wə]	[kɹuː.wə.**l**ækt]

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

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

(25) 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*

(26) *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		*!			*	*

(27) 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.

NATIVISM VS NEUROCONSTRUCTIVISM

Are markedness constraints innate?

(28) 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?

(29) 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)

(30) 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**ŋg**lijə] 'England'.

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

(31) Key ideas:

- Constraints *emerge* in the course of *development*.
- The child transcends the limitations of induction over input data by *accessing her own experience of performance*.

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