The stem-level syndrome

Ricardo Bermúdez-Otero
University of Manchester

INTRODUCTION

§1 This paper seeks to ascertain and explain the properties of phonological processes

whose morphosyntactic domain is smaller than the grammatical word,

i.e. whose morphosyntactic domain systematically excludes certain morphological exponents (e.g. certain affixes).

Empirically, evidence is drawn from the phonology of so-called 'class-one' forms in English.

§2 This problem was first clearly put on the agenda by rule-based Lexical Phonology (Pesetsky 1979; Kiparsky 1982a, b; etc).

Lexical Phonology had the means to formulate and address this question:

- Lexical Phonology sorted phonological rules into levels (Siegel 1974, Allen 1978) by the contents of their morphosyntactic domains;

  therefore, 'level-one' (henceforth, 'stem-level') phonological rules constituted a recognized theoretical category.

- Lexical Phonology imported from the syntax of its time the notion of 'conditions on transformations' (Chomsky 1973);

  therefore, the peculiar properties of the stem level were thought to be expressible as conditions on rule application, such as the Strict Cycle Condition and Structure Preservation.

In addition, Lexical Phonology had strong motives to ask these questions:

since the stem level contained the phonological rules applying earliest in the derivation, it was hoped that a theory of the stem level would solve the problems inherited from *SPE*'s approach to underlying representations,

viz. the abstractness problem (e.g. Kiparsky 1968, Hyman 1970, Crothers 1971, etc.)

the duplication problem (e.g. Stanley 1967: §1.5-§1.6; *SPE*: 382; Clayton 1976; Kenstowicz and Kisseberth 1977: 136ff.)

§3 *The stem-level syndrome according to Lexical Phonology*

In classical Lexical Phonology (e.g. Kaisse and Shaw 1985, Kiparsky 1985), stem-level phonological rules were hypothesized to possess the following attributes:

- cyclic reapplication — they reapplied after each stem-level morphological operation;
- strict cyclicity — they were subject to blocking in nonderived environments;
- structure preservation — they were not allowed to create allophones.

§4 *The stem-level syndrome: the facts*

The present-day English evidence examined in this paper suggests that the theory outlined in §3 provides some useful insights but requires very extensive modifications.

To the extent that English is representative, the facts turn out to be as follows:

(1) Stem-level phonological processes may or may not display cyclic reapplication.

(2) Stem-level phonological processes may or may not be purely allophonic in minimal domains.

(3) If a stem-level phonological process does display cyclic reapplication, then it is not purely allophonic in minimal domains: it is robustly or at least marginally neutralizing.

(4) Cyclic reapplication, when it does occur, is irreducibly lexically irregular.

(5) The probability of cyclic reapplication shows an effect of the relative token frequency of the base and of the derived form.

(6) The probability of cyclic reapplication shows an effect of the perceptibility of the output of reapplication.

(7) Word-level and phrase-level phonological processes do not display cyclic reapplication.

§5 *The stem-level syndrome: an emergentist approach (Bermúdez-Otero 2012)*

This paper argues that the key to the observations laid out in §4 lies in patterns of lexical listing:

- nonanalytic listing — every representation generated by the stem-level morphophonology is stored undecomposed in the lexicon;
- analytic listing — word- and phrase-level constructs are either not stored or stored as decomposed assemblies of stem-level representations.

Given this single postulate (which presupposes a stratal distinction between stem, word, and phrase levels), the facts listed in §4 emerge from the interaction of independently motivated mechanisms, viz.

- morphological blocking as implemented in dual-route race models,
- the markedness and IO-faithfulness technology of Optimality Theory.

THE STEM-LEVEL SYNDROME ACCORDING TO LEXICAL PHONOLOGY

Identifying stem-level phonological processes

§6 *A canonical example of a stem-level phonological rule*

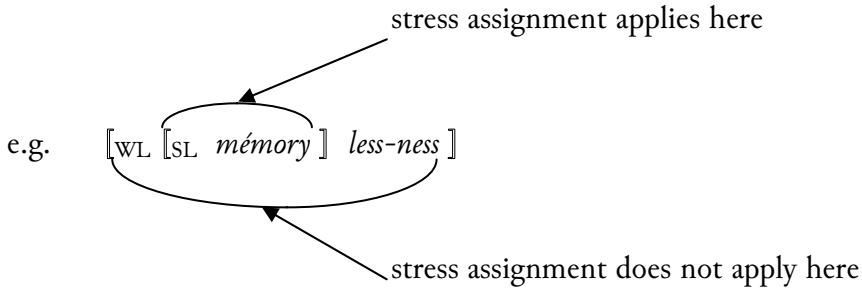
English stress assignment (foot-head creation)
Build a right-aligned bimoric trochee under final syllable extrametricality (e.g. nouns) or final consonant extrametricality (e.g. verbs, adjectives).

E.g. (nouns)

normal application (monomorphemic items)			**normal application** (stem-level suffixes)	**misapplication** (word-level suffixes)
América	*aréna*	*veránda*	*consúlt* → *consult-átion*	*schólar-**ship*** (heavy penult skipped!)
cínema	*horízon*	*synópsis*	*géneral* → *generál-ity*	*devélop-**ment*** (heavy penult skipped!)
jávelin	*angína*	*uténsil*		*mémory-**less-ness*** (outside 3σ window!)

§7 *Cyclic misapplication*

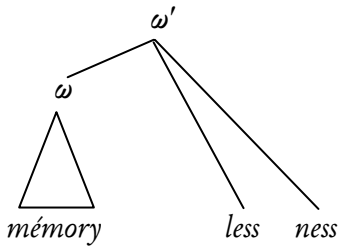
'Class-two' (henceforth, 'word-level') suffixes are systematically excluded from the morphosyntactic domain of stress assignnment:



In consequence, stress assignment misapplies in the presence of word-level suffixes.

§8 Defining stem-level phonological rules in terms of cyclic misapplication presupposes that we have criteria for distinguishing between the latter and transparent prosodic conditioning:

e.g. transparent prosodic alternative to §7 (Szpyra 1989: 178-200, Hammond 1999)



constraints on the alignment of feet hold within ω^{o}, not ω'

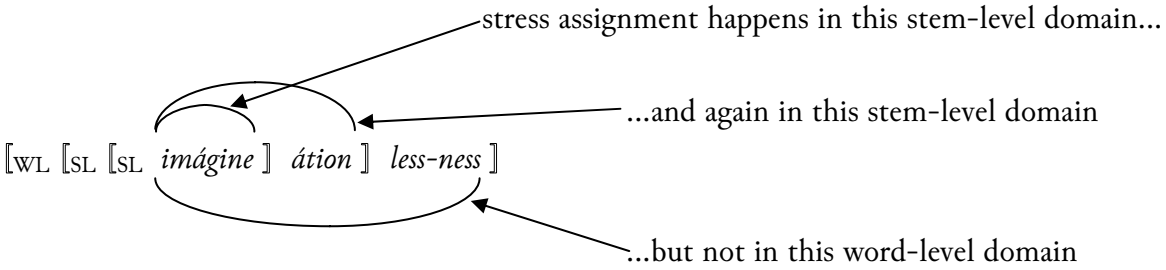
Distinguishing between cyclic misapplication and prosodic conditioning is not easy (Raffelsiefen 2005; Scheer 2011, 2012), but see Bermúdez-Otero and Luís (2009: §7-§14) and Bermúdez-Otero (2011: §4) for

- a set of general criteria,

and • specific arguments against the adjunction of English word-level suffixes under *ω′*

Cyclic reapplication

§9 A case of cyclic reapplication of stress assignment: *imàgin-átion-less-ness*



Stress assignment cannot apply in a single pass over *imagination* because this would yield **ìmaginátion* by the Abracadabra Rule (cf. *àbracadábra, dèlicatéssen, Mèditerránean, càtamarán,* etc).

§10 Another instance of cyclic reapplication: trisyllabic shortening (TSS)

⟦SL ⟦SL ⟦SL *metre* ⟧ *ical* ⟧ *ity* ⟧

mét̆re	the initial *σ* does not qualify for TSS	(normal nonapplication)
mét̆rical	the initial *σ* qualifies for TSS	(normal application)
mĕ̆tricálity	the initial *σ* does not qualify for TSS	(cyclic overapplication)

Trisyllabic shortening cannot apply in a single pass over *metricality* because this would produce **mētricálity* (cf. *fāte ~ fātal ~ fātálity*).

§11 Lexical Phonology asserts that all stem-level phonological rules will show cyclic reapplication.

This is because

- every stem-level morphological operation defines a cyclic domain for the rules of the stem-level phonology,
- and, therefore, every stem-rule must apply in every stem-level cycle so defined.

Strict cyclicity

§12 Stem-level rules like trisyllabic shortening have lexical exceptions among monomorphemic items:

e.g. *īvory, nīghtingale, Ōberon, stēvedore, vāgary*, etc.

§13 In Lexical Phonology, these exceptions were handled by means of the Strict Cycle Condition:

> A cyclic rule can apply in structure-changing fashion to a representation *r* only if *r* has been derived by the application of a morphological rule or by a structure-changing application of a phonological rule in the same cycle.

The Strict Cycle Condition originated in transformational syntax (Chomsky 1973), was immediately extended to phonology (Kean 1974, Mascaró 1976, Halle 1979, Pesetsky 1979: §3.1), and subsequently revised as shown above (Kiparsky 1985: 89-91, Halle and Mohanan 1985: 97, Kaisse and Shaw 1985: 22).

§14 Q: Why analyse the exceptions in §12 as instances of blocking in nonderived environments? After all, trisyllabic shortening has exceptions in derived environments too: e.g. *obēs-ity, nōt-ify*, etc.

A: Lexical Phonology had inherited *SPE's* evaluation measure, which favoured the elimination of exceptions by means of highly abstract underliers such as the notorious /n**ix**tVngǣl/ 'nightingale' (see §2 above). The Strict Cycle Condition enabled Lexical Phonology to avoid this particular embarrassment while otherwise retaining the machinery of *SPE* virtually intact.

For historical discussion, see Kaisse and Shaw (1985: §4.1), Bermúdez-Otero (2012: §3.2).

§15 The upshot is that Lexical Phonology asserts that all stem-level phonological rules will display nonderived environment blocking.

Structure preservation

§16 Trisyllabic shortening is neutralizing; cf. prefortis clipping (PFC) which is purely allophonic.

TSS(/iː/) = [ɛ] = /ɛ/ *ser*[iː]*ne* ~ *ser*[ɛ]*nity*
PFC(/iː/) = [i·] ≠ /ɪ/ *s*[iː]*d* ~ *s*[i·]*t*

Lexical phonologists assumed that *all* stem-level phonological rules had to be neutralizing:

> A [level-one] phonological rule may not apply to create some segment which is nondistinctive—that is, not a phoneme of the language (Borowsky 1989: 148).

§17 This generalization was implemented by means of Structure Preservation, a condition on stem-level rule application which, like the Strict Cycle Condition (§13), traced its intellectual origins to work in syntax (Emonds 1970):

> Marking conditions applicable to underived lexical representations apply also to lexical representations derived at the stem level (after Kiparsky 1985: 92).

In fact, this formulation raised some tricky technical problems (e.g. Macfarland and Pierrehumbert 1991, Kaisse and Hargus 1994).

Nonetheless, its appeal lay in the fact that it was perceived as providing a principled solution to *SPE*'s duplication problem, which arose from the partial overlap between morpheme structure constraints and transformations (see §2 above).

Interim summary

§18 According to Lexical Phonology, stem-level phonological rules possess the following properties (repeated from §3):

- cyclic reapplication — they reapply after each stem-level morphological operation;
- strict cyclicity — they are subject to blocking in monomorphemic items;
- structure preservation — they are not allowed to create allophones.

PROBLEMS FOR LEXICAL PHONOLOGY

Irregular cyclic reapplication

§19 *The* tràns*p*[ə]rtátion *problem*

In English, cyclic reapplication of stress assignment is notoriously irregular among stem-level derivatives containing pretonic sequences of two heavy syllables of which the second is closed by a sonorant consonant.

See Chomsky and Halle (1968: 38-39, 116, 161), Liberman and Prince (1977: 299-304), Kiparsky (1979: 428-29), Halle and Kenstowicz (1991: 460-61), Burzio (1994: §6.3), Pater (2000), Marvin (2002: 60-70), Hammond (2003), Collie (2007: ch. 2), and Kraska-Szlenk (2007: §8.1.2), among others.

a.	the reapplication pattern		*cond*[ɛ́]*mn*	*còndmn-átion*
			imp[ɔ́]*rt*	*ìmp*[ɔ̀]*rt-átion*
		cf.	*cómp*[ə]*nsàte*	*còmp*[ə]*nsát-ion*
			cónt[ə]*mplàte*	*còntmplát-ion*
b.	the non-reapplication pattern		*cons*[ɜ́]*rve*	*còns*[ə]*rv-átion*
			tràns[ɔ́]*rt*	*tràns*[ə]*rt-átion*

§20 *Not reducible to morphosyntactic constituency,* pace SPE *and DM*

- Chomsky and Halle's (1968: 39, 112, 116) suggested solution for the *tràns*[ə]*rtátion* problem:

  (a) semantics of argument-structure nominal ⇨ stem-based derivation ⇨ reapplication
  (b) semantics of referential nominal ⇨ root-based derivation ⇨ non-reapplication

  e.g. (a) *còndnsátion* ⟦$_{N}$ ⟦$_{V}$ condense⟧ ation⟧ 'act of condensing'
  Andrew's skilful condnsation of the argument into a few sentences was brilliant.

  (b) *còndnsátion* ⟦$_{N}$ ⟦$_{V}$ condense⟧ ation⟧ 'condensed substance'
  I used a cloth to wipe the condnsation from the windscreen.

For argument-structure vs. referential nominals, see Borer (2003: §4). For the inability of roots to trigger cycles, see Kiparsky (1982b: 32-33, 1982a: 144-45) and Inkelas (1989: §3.5.5). Chomsky and Halle's idea has recently been restated in terms of Phase Theory (e.g. Marvin 2002: 39, Arad 2003: 740, Embick and Marantz 2008: 11, Embick 2010).

- But the correlation does not in fact hold up:

  In Noboa, *the plaintiffs argued that the airline's transp*[ə]*rtation of the human ashes in the valuable cargo section of the aircraft* [...] *was sufficient to justify a finding of wilful misconduct on the part of the airline.*
  (International Air Transport Association, *The Liability Reporter*, 9, February 2006)

§21 *The effect of relative token frequency*

Non-reapplication is more likely when the base has lower token frequency than the derivative:

			tokens per millions words in spoken section of COCA		
			base		derivative
a.	reapplication				
	cond[ɛ́]*mn*	*còmd*[ɛ̀]*mn-átion*	7.09	>	2.57
	imp[ɔ́]*rt*	*ìmp*[ɔ̀]*rt-átion*	5.15	>	0.62
b.	variable pattern				
	cond[ɛ́]*nse*	*còmd*[ɛ̀~ə]*ns-átion*	0.28	≈	0.22
c.	non-reapplication				
	cons[ɜ́]*rve*	*còns*[ə]*rv-átion*	1.65	<	9.11
	tràmsp[ɔ́]*rt*	*tràmsp*[ə]*rt-átion*	7.23	<	23.54

Anecdotal data from Bermúdez-Otero (2012: §3.3.3), based on Kraska-Szlenk (2007: §8.1.2). In a more rigorous statistical study, Collie (2007, 2008) finds a similar effect among stem-level derivatives with trisyllabic pretonic sequences of the types *σ̄σ̆σ́*... and *σ̄σ̄σ́*...:

e.g. *antícipate* ~ *antìcipát-ion* (reapplication) ~ *ànticipát-ion* (nonreapplication).

§22 *The effect of relative perceptibility*

- The likelihood that stress assignment will fail to reapply cyclically varies according to context in the derived form:

probability of non-reapplication:

*σ̀*__*σ́*...	e.g.	*tràmsp*[ə]*rtátion*, despite *tràmsp*[ɔ́]*rt*
>		
*σ̀*__*σ̆σ́*...	e.g.	*ànticipátion*, despite *antícipate*
>		
*σ̆*__*σ̆σ́*...	e.g.	*dìssimilátion*, despite *dissímilate*

See Collie (2007: 149) for a rigorous comparison of the *ànticipátion* and *dìssimilátion* cases using dictionary data (Jones 2003).

- One possible interpretation of this cline is that it reflects relative perceptibility (Bermúdez-Otero 2012: §3.3.3):

  the contextual phonetic cues to metrical prominence (presence of a foot-head) are

  better in $\breve{\sigma}$__$\breve{\sigma}$ (target syllable relatively long; flanking syllables headed by reduced vowels)
  worse in $\grave{\breve{\sigma}}$__$\acute{\breve{\sigma}}$ (target syllable relatively short; flanking syllables headed by full vowels).

Misclassified phonological processes

§23 The theory of the stem level laid out in §3/§18 forced Lexical Phonology to assign a large number of English phonological processes to the word-level, even though their domain excludes word-affixes:

e.g.	postnasal stop deletion	*lon~~g~~*	~	*e-long-ate*	~	*lon~~g~~-ish*
	nasal cluster simplification	*dam~~n~~*	~	*damn-ation*	~	*dam~~n~~-ing*
	Belfast dentalization	*fa*[t]	~	*sani*[t̪]*-ary*	~	*fa*[t]*-er*
	the GOAT split	*p*[ɒʊ]*l*	~	*p*[ʌʊ]l*-ar*	~	*r*[ɒʊ]*ll-er*
	etc.					

Works demonstrating a troubled awareness of this problem include Borowsky (1993) and Harris (1989).

§24 *The GOAT split*

Vernacular London varieties (see Wells 1982: 312-3, Sampson 1985, Harris 1990: 97-8):

/ʌʊ/ → [ɒʊ] / __ l $_{\sigma}$]

normal application		**normal nonapplication**	
ɒʊl$_{\sigma}$] in monomorphemic items		ʌʊ.lV in monomorphemic items	
[ɒʊ]	*coal*	[ʌʊ]	*cola*, *coley* 'type of fish'
	hole		*holy* 'sacred'
	roll		*Roland*
	Walpole		
	pole, poll		

normal nonapplication		**overapplication**	
ʌʊ.lV with stem-level suffixes		ɒʊ.lV with word-level suffixes	
[ʌʊ]	*Mongol-ian*	[ɒʊ]	*coal-y* 'coal-like'
	Walpol-ian[†]		*hol-ey* 'full of holes'
	pol-ar		*roll-er, roll-ing*
			poll-er, poll-ing

[†] An established word for same speakers, but elicited as a nonce form from Sampson's (1985: 289) informants.

§25 By the criteria discussed in §6–§8 above, the GOAT-split rule must be stem-level, since its morphosyntactic domain includes stem-level suffixes and excludes word-level suffixes.

But the rule has **none** of the properties of the stem-level syndrome as characterized by Lexical Phonology (cf. §3/§18)!

- It never displays cyclic reapplication: ⟦$_{SL}$ ⟦$_{SL}$ *Walp*/ʌʊ/*le*⟧ *ian*⟧
  Walp[ɒʊ]*le*
  **Walp*[ɒʊ]*l-ian* (Sampson 1985: 289, Harris 1990: 98)
- It applies in nonderived environments: *c*[ɒʊ]*l, h*[ɒʊ]*le, p*[ɒʊ]*le, r*[ɒʊ]*ll*, etc.
- It is purely allophonic: [ɒʊ] is an allophone with a fully predictable distribution

§26 *Lexical Phonology in retreat: back to boundaries*

The escape manoeuvre: replace syllable boundaries with morphological brackets.

/ʌʊ/ → [ɒʊ] / __ l ⟧ (word level) see Harris (1990: 98).

This was in fact the generally accepted way to cope with the processes in §23:
see e.g. Mohanan (1982: 121) and Halle and Mohanan (1985: 96) on postnasal plosive deletion.

§27 Sample derivations

		'Walpole'	'Walpol-ian'	'Walpol-ey'
UR		*Walp*/ʌʊ/*le*	*Walp*/ʌʊ/*le*	*Walp*/ʌʊ/*le*
SL	morphology	*Walp*/ʌʊ/*le*⟧	*Walp*/ʌʊ/*le*⟧ *ian*⟧	*Walp*/ʌʊ/*le*⟧
	phonology (§26 active)	—	—	—
Bracket Erasure		.....		
WL	morphology	*Walp*/ʌʊ/*le*⟧	*Walp*/ʌʊ/*lian*⟧	*Walp*/ʌʊ/*le*⟧ *ey*⟧
	phonology (§26 inactive)	[ɒʊ]	—	[ɒʊ]

If internal brackets are erased at the end of each level (Kiparsky 1982a: 140; cf. *SPE:* 20), then the internal morphosyntactic structure of stem-level derivatives (e.g. *Walpol-ian*) becomes invisible to rule §26 at the word level, whereas that of word-level derivatives (e.g. *Walpol-ey*) remains accessible.

§28 But §26 is basically a retreat to *SPE*'s theory of boundary symbols!

cf. /ʌʊ/ → [ɒʊ] / __ l #

§29 This trick devalues the concept of cyclic domain:

According to §26, /l/ causes /ʌʊ/ to be retracted when immediately followed by a visible morphological bracket at the word-level.

So, the rule does not know or care what is on the other side of the bracket: i.e. the GOAT-split rule cannot see word-level suffixes at all, since they are on the other side of the bracket.

But, surely, being blind to word-level morphology is the very definition of being stem-level!

☞ Rule §26 is a cheap trick to bypass the evidence of morphosyntactic domains:
it allows a rule whose true domain is the stem level to be assigned to the word level.

Insights to salvage

§30 The Lexical Phonology approach to the stem-level syndrome (§3/§18) appears to be in tatters.

But let's not be hasty: there are key insights to be salvaged!

§31 *Cyclic reapplication only happens at the stem level*

(1) Stem-level phonological processes need not show cyclic reapplication (§25); when they do, reapplication displays varying degrees of lexical irregularity (§19-§22).

(2) **But** word-level and phrase-level phonological processes seem never to display cyclic reapplication.

- As an example of a genuine word-level process, consider final devoicing in German and Dutch (e.g. Booij 1997): no cyclic reapplication!

e.g.	nom.sg.	*ein-ig*	[ae.nɪ**ç**]		
	gen.sg.	*ein-ig-es*	[ae.nɪ.**g**əs]		
	gen.sg.	domains	✓ ⟦$_{WL}$ ⟦$_{SL}$ aen ⟧ ɪɣ-əs ⟧	✖ ⟦$_{WL}$ ⟦$_{WL}$ ⟦$_{SL}$ aen ⟧ ɪɣ ⟧ əs ⟧	
		SL	aen	aen	
		WL	ae.nɪ.gəs	ae.nɪ**ç**	
				*ae.nɪ.**ç**əs	

- Indeed, the absence of cyclic reapplication in the phrase-level phonology (*pace* e.g. McHugh 1990, 2006) is an acknowledged mystery for Phase Theory: see Scheer (2011: §794ff).

§32 *Purely allophonic processes do not show cyclic reapplication*

For those stem-level processes that do show cyclic reapplication, the Lexical Phonology approach is fairly close to the mark:

cyclically reapplying processes are never purely allophonic in minimal domains;
rather, they are robustly neutralizing (i.e. the output is phonemically contrastive)
or, at least, marginally neutralizing (i.e. they sustain lexical exceptions).

This is enunciated as **Chung's Generalization** in Bermúdez-Otero (2012: 31).
See also the Appendix below (page 22).

- English

stress	cyclic reapplication	*imágine* → *imàginátion*	*imp*[ɔ́]*rt* → *ìmp*[ɔ̀]*rtátion*
	contrasts	*apòtheósis* ~ *àbracadábra*	*Mòz*[ǽ]*mbíque* ~ *Pènns*[ə́]*lvánia*
TSS	cyclic reapplication	(*mētre* →) *mĕtrical* → *mĕtricality*	
	contrasts	*phrĕnological* ~ *cētological*	

Further examples listed in Bermúdez-Otero (2012: §3.3).

- Russian (Pesetsky 1979: §1.3)

- Chamorro (Chung 1983: 63)

Interim summary

§33 Rather than §3/§18, an accurate characterization of the stem-level syndrome would be as follows (repeated from §4):

(1) Stem-level phonological processes may or may not display cyclic reapplication.
(2) Stem-level phonological processes may or may not be purely allophonic in minimal domains.
(3) If a stem-level phonological process does display cyclic reapplication, then it is not purely allophonic in minimal domains: it is robustly or at least marginally neutralizing.
(4) Cyclic reapplication, when it does occur, is irreducibly lexically irregular.
(5) The probability of cyclic reapplication shows an effect of the relative token frequency of the base and of the derived form.
(6) The probability of cyclic reapplication shows an effect of the perceptibility of the output of reapplication.
(7) Word-level and phrase-level phonological processes do not display cyclic reapplication.

THE STEM-LEVEL SYNDROME: AN EMERGENTIST APPROACH

§34 I now proceed to describe a grammatical framework in which the facts of §33 emerge.

[See Bermúdez-Otero 2012 for a full description and discussion of intellectual ancestry. For closely related work, see Bermúdez-Otero and McMahon 2006; Kiparsky 2007; Collie 2007, 2008.].

Its key ingredients are:

(1) phonological stratification (with three levels: the stem, word, and phrase levels)
[e.g. Booij and Rubach 1987, Kiparsky 2000];

(2) the markedness and IO-faithfulness technology of classic OT (without OO-correspondence)
[see Prince and Smolensky 1993, McCarthy and Prince 1995];

(3) morphological blocking as implemented in dual-route race models of morphology
[for race models, see e.g. Schreuder and Baayen 1995, Baayen et al. 1997, Hay 2003;

(4) a distinction between two types of lexical listing: nonanalytic and analytic
[e.g. Stemberger and MacWhinney 1986, 1988; Clahsen and Neubauer's 2010: 2634].

§35 As the references in §34 show, all these elements are independently motivated.

I add one single stipulation, concerning the relationship between (1) and (4):

- Nonanalytic listing of stem-level expressions
  Every representation generated by the stem-level morphophonology is stored undecomposed in the lexicon.
- Nonlisting or analytic listing of word-level and phrase-level expressions
  Word- and phrase-level constructs are either not stored or stored as decomposed assemblies of stem-level representations.

On analytic and nonanalytic listing

§36 Psycholinguistic evidence for two types of listing (Stemberger and MacWhinney 1986, 1988)

(i) English speakers make significantly fewer production errors in high-frequency than in low-frequency regular past-tense forms:

e.g. experiment in Stemberger and MacWhinney (1988: 106)

verb type	trials	errors	rate
low frequency	700	28	.037
high frequency	700	13	.017

If production accuracy if facilitated by lexical listing,
then high-frequency regular past-tense forms are lexically listed.

(ii) Affix shifts: e.g. *Tell-us-ing* for *tell-ing us*
Let go-ing for *lett-ing go*

Affix shifts affect high-frequency regularly inflected forms, which according to (i) are lexically listed, at the same rates as low-frequency regularly inflected forms.

If affix shifts imply that inflected items enter the computation as two pieces,
then those inflected forms that are listed must be listed <u>analytically</u>: as sequences of two pieces.

§37 Nonanalytic listing of stem-level expressions allows phonological exceptions to arise via blocking:

nonanalytic ✓ ARABIC ↔ [$_{\omega}$ ˈæ.ɹæ.bɪk] (blocks stress assignment to the penult)

analytic ✖ ARABIC ↔ ⟦$_{SL}$ æɹæb - ɪk⟧ (yields *[$_{\omega}$ æ.ˈɹæ.bɪk] by on-line computation)

In contrast, analytic listing of word-level constructs predicts phonological regularity:

e.g. past-tense inflection with /d/

/-d/	→ [-ɪd]	after /t, d/	[ˈpæt-ɪd, ˈæd-ɪd]
	[-t]	after voiceless segments other than /t/	[tɹæp-t, pæk-t, kəˈlæps-t, pætʃ-t]
	[-d]	elsewhere	[ˈpleɪ-d, seɪv-d, bæn-d]

This alternation is strictly exceptionless (Albright and Hayes 2003: 151) because it is always computed on-line, the relevant forms being either unlisted or listed analytically.

Cyclic reapplication via nonanalytic listing and blocking

§38 Consider the case of a speaker lacking a lexical entry for *originality* and deriving the form on-line:

- By the nonanalytic listing of stem-level expressions, the lexical entry of the base *oríginal* will be as follows:

  ORIGINAL ↔ [$_{\omega}$ *o.rí.gi.nal*]

- By morphological blocking, derivation from underlying /*origin* + *al* + *ity*/ is blocked:
  the lexical entry of ORIGINAL blocks the suffixation of /*-al*/ to /*origin*/

- So the input to phonology is

  [$_{\omega}$ *o.rí.gi.nal*]+/*ity*/,

  whence

[$_{\omega}$ ***o.rí.***gi.nal]+/ity/	FAITH	ALIGN
[$_{\omega}$ ***ò.***ri.gi.ná.li.ty]	*!	
[$_{\omega}$ ***o.rì.***gi.ná.li.ty] ☜		*

Cyclic reapplication requires high-ranking faithfulness, which creates contrast

§39 In §38 we saw that, for the stress contour of *oríginal* to affect that of *orìginálity*, it must be the case that metrical faithfulness ranks high in the stem-level phonological constraint hierarchy:

i.e. FAITH ≫ ALIGN

But this predicts—correctly—that the Abracadabra Rule, which requires a left-aligned foot in word-initial ŏŏŏó... sequences, is a mere default that can be overriden by underlying specifications:

*a.**pò**.the.ó.sis*	FAITH	ALIGN
[ω ***à**.po.the.ó.sis*]	*!	
[ω *a.**pò**.the.ó.sis*] ☜		*

Key insights:

- Exceptionality and robust contrast are points on the same continuum; they do not differ qualitatively from each other or require different constraint rankings (e.g. Kager 2009: 398, 412, 429).
- Exceptions are not random, but follow patterns captured by the ranking of crucially dominated faithfulness constraints in the stem-level hierarchy: cf. Zuraw's (2000, 2010) 'subterranean constraints'.

§40 Conversely, patterns of complementary distribution require that faithfulness should be ranked low in the stem-level constraint hierarchy.

(a) This rules out lexical exceptions, whatever the content of stored representations:

Walp/ʌʊ/*le*	*ʌʊl$_\sigma$]	*ɒʊ	FAITH
[$_\omega$ *Wal.p*[ʌʊ]*le*]	*!		
[$_\omega$ *Wal.p*[ɒʊ]*le*] ☜		*	*

(b) And it also rules cyclic reapplication, despite the nonanalytic storage of bases:

[$_\omega$ *Wal.p*[ɒʊ]*le*]+/*ian*/	*ʌʊl$_\sigma$]	*ɒʊ	FAITH
[$_\omega$ *Wal.p*[ɒʊ].*li.an*]		*!	
[$_\omega$ *Wal.p*[ʌʊ].*li.an*] ☜			*

§41

We now have an explanation for (1), (2), and (3) in §4/§33:

Given nonanalytic listing of stem-level forms and morphological blocking, then

- high-ranking faithfulness produces cyclic reapplication and contrast/exceptionality;
- low-ranking faithfulness prevents cyclic reapplication and contrast/exceptionality.

The vagaries of blocking: diachronic competition between reapplication and nonreapplication

§42 Why does cyclic reapplication display lexical irregularities?

Because reapplication is driven by morphological blocking (§38), but in a dual-route race model blocking is not guaranteed to succeed: a lexical entry may lose the race against on-line derivation.

§43 *A diachronic scenario*

- In line with the typical life cycle of phonological processes (Bermúdez-Otero and Trousdale 2012, Bermúdez-Otero 2013), let us assume that, historically, the original stress contour of TRANSPORTATION initially showed no reapplication: i.e. *tràns*p[ə]*rtátion*.

  By the nonanalytic listing of stem-level outputs, this was stored as a lexical entry:

  i.e. TRANSPORTATION ↔ [$_{\omega}$ *tràns*p/ə/*rtátion*]

- Again in line with the life cycle of phonological processes, let us assume that, at some point, analogical change gave rise to the innovative reapplication variant *tràns*p[ɔ̀]*rtátion*. A likely scenario is that learners exposed to *tràns*p[ɔ́]*rt* but underexposed to *tràns*p[ə]*rtátion* created *tràns*p[ɔ̀]*rtátion* guided by an antialternation bias (Hayes 2004: 188, Tessier 2006: 275ff).†

  In the grammar, this development, presumably repeated across a number of similar words, had an effect upon the stem-level constraint hierarchy: metrical faithfulness was promoted above the markedness constraint against two-sided clashes.

  In the lexicon, the crucial effect was the rise of a new lexical entry by the nonanalytic listing of stem-level representations:

  i.e. TRANSPORTATION ↔ [$_{\omega}$ *tràns*p/ɔ̀/*rtátion*]

The crucial question now is:
Which of the two variants will prevail and be transmitted to new generations of speakers?

§44 One mechanism boosts the transmission of [$_{\omega}$ *tràns*p/ɔ̀/*rtátion*]:

☞ Whenever on-line derivation from [$_{\omega}$ *tràns*p/ɔ́/*rt*]+/*ation*/ wins the race against lexical search, the output is [$_{\omega}$ *tràns*p[ɔ̀]*rtátion*].

The magnitude of this effect depends on
the relative retrieval speed of TRANSPORT and TRANSPORTATION,
which in turn depends on their relative resting activation,
which in turn depends on their relative token frequency.

† Of course, Stratal OT will **not** implement the antialternation bias as a preference for high-ranking OO-correspondence constraints, since it rejects their existence. Rather, we may assume that the learner prefers to rank IO-faithfulness low, and so complies with the Subset Principle during pure phonotactic learning (Hayes 2004: 167ff), **but** when departing from the identity map she crucially suspects an error if her grammar generates a phonological alternant that she has not encountered previously.

☞ In fact, on-line derivation from [$_{\omega}$ *tràns*p/ɔ/*rt*]+/*ation*/ will typically lose the race against the retrieval of a stored form because low-frequency TRANSPORT has lower resting activation than high-frequency TRANSPORTATION (see §21).

§45 Another mechanism boosts the transmission of [$_{\omega}$ *tràns*p/ə/*rtátion*]:

☞ The foot-head on the second syllable of [$_{\omega}$ *tràns*p/ɔ/*rtátion*] is relatively poorly cued phonetically because the syllable is weaker—and so shorter—than both its neighbours, which are also full-vowelled.

So: [$_{\omega}$ *tràns*p/ɔ/*rtátion*] has a nonzero chance of being misperceived as [$_{\omega}$ *tràns*p/ə/*rtátion*].

The magnitude of this effect defends on phonetic cue strength:

[$_{\omega}$ *tràns*p/ɔ/*rtátion*] runs a greater risk of being misperceived as [$_{\omega}$ *tràns*p/ə/*rtátion*]
than [$_{\omega}$ *dissìmilátion*]of being misperceived as [$_{\omega}$ *dìssimilátion*].

§46 | We now have an emergent explanation for (4), (5), and (6) in §4/§33. |

The word- and phrase-levels: analytic listing does not trigger cyclic reapplication

§47 Why is there no cyclic reapplication at the word and phrase levels?

Because cyclic reapplication requires nonanalytic listing (§38),
but word-and phrase-level forms are either not stored or stored analytically.

E.g. Analytic storage of German *ein-ig* [aenɪç] (see §31(2) above)

EINIG ↔ [$_{\omega}$ aen]+[$_{\sigma}$ ɪɣ]

Therefore, the input representation of gen.sg. *ein-ig-es* will be [$_{\omega}$ aen]+[$_{\sigma}$ ɪɣ]+[$_{\sigma}$ əs];
hence, no cyclic reapplication of word-level coda devoicing.

"Properties assigned in the output of the word-level phonology are [...] not stored, and so cannot be fed again as input to the word-level phonology from the lexicon." (Bermúdez-Otero 2012: §3.1)

§48 As a historiographic aside, practitioners of rule-based Lexical Phonology repeatedly arrived at the insight that the differences between the stem level and the word level have to do with listing:

> "Post-cyclic rules do not feed any dictionary." (Pesetsky 1979: §5.0)
>
> "[...E]ach form derived at Level 1 exists as an independent form in the list. [...T]he Word level is distinguished by the fact that every possible derived form is actively derived [...]." (Borowsky 1993: 219-220)

Unfortunately, these intuitions remained undeveloped, probably because they were coupled with an incorrect characterization of the stem-level syndrome, i.e. §3/§18 instead of correct §4/§33:

see e.g. Borowsky (1993: 220), who retains strict cyclicity and structure preservation.

§49 We have now explained all the generalizations in §4/§33.

FINAL REMARKS

Work still to be done

§50 Pursuing the emergentist approach to the stem-level syndrome outlined in this paper will require tackling at least three questions:

- *Typological* Do the generalizations stated in §4/§33 hold true of languages other than English?
- *Psycholinguistic* How well does the stem-level vs word-level distinction as drawn on phonological grounds correlate with the distinction between analytic and nonanalytic listing as diagnosed by psycholinguistic experiments?
- *Foundational* If the answer to the psycholinguistic question is positive, why do word-level forms undergo analytic listing while stem-level forms are stored nonanalytically? Is this a function of productivity, compositionality, or other factors?

The stem-level syndrome in mainstream OT with OO-correspondence

§51 It is highly unlikely that mainstream OT with OO-correspondence will be able to produce a satisfactory account of the stem-level syndrome.

The syndrome involves a tight connection between morphologically-induced misapplication and contrast (§41), but mainstream OT handles the two phenomena by unrelated bits of correspondence technology:

contrast	⇨ IO-faithfulness
morphologically induced misapplication	⇨ OO-identity

§52 The recent neglect of the stem-level syndrome is depressing, and casts serious doubt on the extent to which phonological theory is likely to display cumulative progress.

Granted, rule-based Lexical Phonology provided an incorrect description and a stipulative explanation—but the phenomenon itself cannot just be ignored: it is real!

REFERENCES

Albright, Adam and Bruce Hayes (2003). 'Rules vs. analogy in English past tenses: a computational/experimental study', *Cognition* 90 (2): 119-61.

Allen, Margaret Reece (1978). *Morphological investigations*. Doctoral dissertation, University of Connecticut, Storrs, CT.

Arad, Maya (2003). 'Locality constraints on the interpretation of roots: the case of Hebrew denominal verbs', *Natural Language and Linguistic Theory* 21 (4): 737-78.

Baayen, Harald, Ton Dijkstra, and Robert Schreuder (1997). 'Singulars and plurals in Dutch: evidence for a parallel dual-route model', *Journal of Memory and Language* 37 (1): 94-117.

Bermúdez-Otero, Ricardo (2011). 'Cyclicity', in Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume, and Keren Rice (eds), *The Blackwell companion to phonology* (vol. 4: *Phonological interfaces*). Malden, MA: Wiley-Blackwell, 2019-48.

— (2012). 'The architecture of grammar and the division of labour in exponence', in Jochen Trommer (ed.), *The morphology and phonology of exponence* (Oxford Studies in Theoretical Linguistics 41). Oxford: Oxford University Press, 8-83.

— (2013). 'Amphichronic explanation and the life cycle of phonological processes', in Patrick Honeybone and Joseph C. Salmons (eds), *The Oxford handbook of historical phonology*. Oxford: Oxford University Press. Available at http://ling.auf.net/lingbuzz/001679.

Bermúdez-Otero, Ricardo and April McMahon (2006). 'English phonology and morphology', in Bas Aarts and April McMahon (eds), *The handbook of English linguistics*. Oxford: Blackwell, 382-410.

Bermúdez-Otero, Ricardo and Ana R. Luís (2009). 'Cyclic domains and prosodic spans in the phonology of European Portuguese functional morphs'. Paper given at the Old World Conference in Phonology 6, Edinburgh, 24 January 2009. Available at www.bermudez-otero.com/bermudez-otero&luis.pdf.

Bermúdez-Otero, Ricardo and Graeme Trousdale (2012). 'Cycles and continua: on unidirectionality and gradualness in language change', in Terttu Nevalainen and Elizabeth Closs Traugott (eds), *The Oxford handbook of the history of English*. New York: Oxford University Press, 691-720.

Booij, Geert (1997). 'Non-derivational phonology meets Lexical Phonology', in Iggy Roca (ed.), *Derivations and constraints in phonology*. Oxford: Clarendon Press, 261-88.

Booij, Geert and Jerzy Rubach (1987). 'Postcyclic versus postlexical rules in Lexical Phonology', *Linguistic Inquiry* 18 (1): 1-44.

Borer, Hagit (2003). 'Exo-skeletal vs. endo-skeletal explanations: syntactic projections and the lexicon', in John Moore and Maria Polinsky (eds), *The nature of explanation in linguistic theory*. Stanford: CSLI Publications, 31-67.

Borowsky, Toni (1989). 'Structure Preservation and the syllable coda in English', *Natural Language and Linguistic Theory* 7: 145-66.

— (1993). 'On the Word level', in Sharon Hargus and Ellen M. Kaisse (eds), *Studies in Lexical Phonology* (Phonetics and Phonology 4). San Diego: Academic Press, 199-234.

Burzio, Luigi (1994). *Principles of English stress*. Cambridge: Cambridge University Press.

Chomsky, Noam (1973). 'Conditions on transformations', in Stephen R. Anderson and Paul Kiparsky (eds), *A Festschrift for Morris Halle*. New York: Holt, Rinehart, and Winston, 232-86.

Chomsky, Noam and Morris Halle (1968). *The sound pattern of English*. New York: Harper & Row.

Chung, Sandra (1983). 'Transderivational constraints in Chamorro phonology', *Language* 59 (1): 35-66.

Clahsen, Harald and Kathleen Neubauer (2010). 'Morphology, frequency, and the processing of derived words in native and non-native speakers', *Lingua* 120 (11): 2627-37.

Clayton, Mary L. (1976). 'The redundance of underlying morpheme-structure conditions', *Language* 52: 295-313.

COCA = The Corpus of Contemporary American English (COCA): 400+ million words, 1990-present., 2008-. Created by Mark Davies, Brigham Young University, Provo, UT. http://www.americancorpus.org/.

Collie, Sarah (2007). *English stress-preservation and Stratal Optimality Theory*. PhD thesis, University of Edinburgh, Edinburgh. Available as ROA-965-0408, Rutgers Optimality Archive, http://roa.rutgers.edu.

— (2008). 'English stress preservation: the case for "fake cyclicity"', *English Language and Linguistics* 12 (3): 505-32.

Crothers, John (1971). *On the abstractness controversy* (Project on Linguistic Analysis Reports, second series, no. 12). Berkeley: Phonology Laboratory, University of California.

Embick, David (2010). *Localism versus globalism in morphology and phonology* (Linguistic Inquiry Monographs 60). Cambridge, MA: The MIT Press.

Embick, David and Alec Marantz (2008). 'Architecture and blocking', *Linguistic Inquiry* 39 (1): 1-53.

Emonds, Joseph (1970). *Root and structure-preserving transformations*. Doctoral dissertation, MIT, Cambridge, MA. Available at http://hdl.handle.net/1721.1/12969.

Halle, Morris (1979). 'Formal vs. functional considerations in phonology', in Bela Brogyanyi (ed.), *Studies in diachronic, synchronic, and typological linguistics: Festschrift for Oswald Szemerényi on the occasion of his 65th birthday*. Amsterdam: Benjamins, 325-41.

Halle, Morris and K. P. Mohanan (1985). 'Segmental phonology of Modern English', *Linguistic Inquiry* 16: 57-116.

Halle, Morris and Michael Kenstowicz (1991). 'The Free Element Condition and cyclic versus noncyclic stress', *Linguistic Inquiry* 22: 457-501.

Hammond, Michael (1999). *The phonology of English: a prosodic optimality-theoretic approach* (The Phonology of the World's Languages). Oxford: Oxford University Press.

— (2003). 'Frequency, cyclicity, and optimality'. Paper given at Second International Korean Phonology Conference, Seoul National University, Seoul, 13-14 June 2003. Available at http://www.u.arizona.edu/~hammond/kslides.pdf.

Harris, John (1989). 'Towards a lexical analysis of sound change in progress', *Journal of Linguistics* 25: 35-56.

— (1990). 'Derived phonological contrasts', in Susan Ramsaran (ed.), *Studies in the pronunciation of English: a commemorative volume in honour of A.C. Gimson*. London: Routledge, 87-105.

Hay, Jennifer (2003). *Causes and consequences of word structure*. London: Routledge.

Hayes, Bruce (2004). 'Phonological acquisition in Optimality Theory: the early stages.' in René Kager, Joe Pater, and Wim Zonneveld (eds), *Constraints in phonological acquisition*. Cambridge: Cambridge University Press, 158-203.

Hyman, Larry M. (1970). 'How concrete is phonology?' *Language* 46 (1): 58-76.

Inkelas, Sharon (1989). *Prosodic constituency in the lexicon*. Doctoral dissertation, Stanford University, Stanford, CA. Published (1990), New York: Garland.

Jones, Daniel (2003). *Cambridge English pronouncing dictionary* (16th edn). Cambridge: Cambridge University Press.

Kager, René (2009). 'Lexical irregularity and the typology of contrast', in Kristin Hanson and Sharon Inkelas (eds), *The nature of the word: studies in honor of Paul Kiparsky*. Cambridge, MA: The MIT Press, 397-432.

Kaisse, Ellen M. and Patricia A. Shaw (1985). 'On the theory of Lexical Phonology', *Phonology Yearbook* 2: 1-30.

Kaisse, Ellen M. and Sharon Hargus (1994). 'When do linked structures evade Structure Preservation?' in Richard Wiese (ed.), *Recent developments in Lexical Phonology* (Arbeiten des Sonderforschungsbereichs 282, Theorie des Lexicons, vol. 56). Düsseldorf: Heinrich Heine Universität, 185-204.

Kean, Mary-Louise (1974). 'The strict cycle in phonology', *Linguistic Inquiry* 5 (2): 179-203.

Kenstowicz, Michael and Charles Kisseberth (1977). *Topics in phonological theory*. New York: Academic Press.

Kiparsky, Paul (1968). 'How abstract is phonology?' Bloomington: Indiana University Linguistics Club. Published with some revisions as part 1 of Paul Kiparsky (1973), 'Phonological representations', in Osamu Fujimura (ed.), *Three dimensions of linguistic theory*. Tokyo: TEC, 5-56. Reprinted in Paul Kiparsky (1982), *Explanation in phonology*. Dordrecht: Foris, 119-163.

— (1979). 'Metrical structure assignment is cyclic', *Linguistic Inquiry* 10 (3): 421-41.

— (1982a). 'From Cyclic Phonology to Lexical Phonology', in Harry van der Hulst and Norval Smith (eds), *The structure of phonological representations* (vol. 1). Dordrecht: Foris, 131-75.

— (1982b). 'Lexical Morphology and Phonology', in In-Seok Yang for the Linguistic Society of Korea (ed.), *Linguistics in the morning calm: selected papers from SICOL-1981* (vol. 1). Seoul: Hanshin Publishing Company, 3-91.

— (1985). 'Some consequences of Lexical Phonology', *Phonology Yearbook* 2: 85-138.

— (2000). 'Opacity and cyclicity', in Nancy A. Ritter (ed.), *A review of Optimality Theory*. Special issue, *The Linguistic Review* 17 (2-4): 351-67.

— (2007). 'Description and explanation: English revisited'. Paper given at the 81st Annual Meeting of the Linguistic Society of America, Anaheim, 5 January 2007. Slides available at http://www.stanford.edu/~kiparsky/Papers/lsa2007.1.pdf.

Kraska-Szlenk, Iwona (2007). *Analogy: the relation between lexicon and grammar* (LINCOM Studies in Theoretical Linguistics 38). Munich: LINCOM Europa.

Liberman, Mark and Alan Prince (1977). 'On stress and linguistic rhythm', *Linguistic Inquiry* 8 (2): 249-336.

Macfarland, Talke and Janet B. Pierrehumbert (1991). 'On ich-Laut, ach-Laut and Structure Preservation', *Phonology* 8 (1): 171-80.

Marvin, Tatjana (2002). *Topics in the stress and syntax of words*. PhD dissertation, MIT, Cambridge, MA.

Mascaró, Joan (1976). *Catalan phonology and the phonological cycle*. Doctoral dissertation, MIT, Cambridge, MA.

McCarthy, John J. and Alan Prince (1995). 'Faithfulness and reduplicative identity', in Jill Beckman, Suzanne Urbanczyk, and Laura Walsh Dickey (eds), *Papers in Optimality Theory* (University of Massachusetts Occasional Papers in Linguistics 18). Amherst, MA: GLSA, University of Massachusetts, 249-384.

McHugh, Brian (1990). 'The phrasal cycle in Kirunjo Chaga tonology', in Sharon Inkelas and Draga Zec (eds), *The Phonology-Syntax Connection*. Chicago: University of Chicago Press, 217-42.

— (2006). *Cyclicity in the phrasal phonology of KiVunjo Chaga* (LINCOM Studies in African Linguistics 03). Munich: Lincom GmbH.

Mohanan, K. P. (1982). *Lexical Phonology*. Doctoral dissertation, MIT, Cambridge, MA.

Pater, Joe (2000). 'Nonuniformity in English secondary stress: the role of ranked and lexically specific constraints', *Phonology* 17: 237-74.

Pesetsky, David (1979). 'Russian morphology and lexical theory'. Ms. Cambridge, MA: MIT. Available at http://web.mit.edu/linguistics/www/pesetsky/russmorph.pdf.

Prince, Alan and Paul Smolensky (1993). *Optimality Theory: constraint interaction in generative grammar* (Technical Reports of the Rutgers University Center for Cognitive Science, RuCCS-TR-2). New Brunswick, NJ: Rutgers University Center for Cognitive Science. Corrected version (2002) available as ROA-537-0802, Rutgers Optimality Archive, http://roa.rutgers.edu. Published (2004), Oxford: Blackwell.

Raffelsiefen, Renate (2005). 'Paradigm uniformity effects versus boundary effects', in Laura J. Downing, T. Alan Hall, and Renate Raffelsiefen (eds), *Paradigms in phonological theory*. Oxford: Oxford University Press, 211-62.

Sampson, Rodney (1985). 'The "GOAT split": a phonological puzzle in one variety of English', *Anglia* 103: 282-96.

Scheer, Tobias (2011). *A guide to morphosyntax-phonology interface theories: how extra-phonological information is treated in phonology since Trubetzkoy's Grenzsignale*. Berlin: Mouton de Gruyter.

— (2012). 'Chunk definition in phonology: prosodic constituency vs. phase structure', in Maria Bloch-Trojnar and Anna Bloch-Rozmej (eds), *Modules and Interfaces*. Lublin: Wydawnictwo KUL, 221-53.

Schreuder, Robert and Harald Baayen (1995). 'Modeling morphological processing', in Laurie Beth Feldman (ed.), *Morphological aspects of language processing*. Hillsdale, NJ: Lawrence Erlbaum Associates, 131-54.

Siegel, Dorothy C. (1974). *Topics in English morphology*. Doctoral dissertation, MIT, Cambridge, MA. Published (1979), New York: Garland.

Stanley, Richard (1967). 'Redundancy rules in phonology', *Language* 43 (2): 393-436.

Stemberger, Joseph Paul and Brian MacWhinney (1986). 'Frequency and the lexical storage of regularly inflected words', *Memory and cognition* 14 (1): 17-26.

— (1988). 'Are inflected forms stored in the lexicon?' in Michael Hammond and Michael Noonan (eds), *Theoretical morphology: approaches in modern linguistics*. San Diego: Academic Press, 101-16.

Szpyra, Jolanta (1989). *The phonology-morphology interface: cycles, levels and words* (Croom Helm linguistics series). London: Routledge.

Tessier, Anne-Michelle (2006). *Biases and stages in phonological acquisition*. Doctoral dissertation, University of Massachusetts, Amherst, MA. Available as ROA-883-1106, Rutgers Optimality Archive, http://roa.rutgers.edu.

Wells, J. C. (1982). *Accents of English* (3 vols). Cambridge: Cambridge University Press.

Zuraw, Kie (2000). *Patterned exceptions in phonology*. Doctoral dissertation, University of California, Los Angeles.

— (2010). 'A model of lexical variation and the grammar with application to Tagalog nasal substitution', *Natural Language and Linguistic Theory* 28: 417-72.

CONTACT DETAILS

Ricardo Bermúdez-Otero
Linguistics and English Language
University of Manchester
Oxford Road
Manchester M13 9PL
United Kingdom

r.bermudez-otero@manchester.ac.uk
www.bermudez-otero.com

APPENDIX

Chung's Generalization: executive summary

Chung's Generalization (Bermúdez-Otero 2012: 31; §32 above) forbids the cyclic transmission of allophonic properties from a base to a stem-level derivative, but allows such transmission freely across strata: e.g. from a base to a word-level derivative. The meaning of this assertion is best illustrated with the GOAT split (§24):

(1) The presence of the retracted allophone [ou] is predictable in both *(electoral) p**o**ll* and *(North) p**o**le*. This is due to the low ranking of IDENT in the stem-level constraint hierarchy (§40(a)):

i.e. $*\text{ʌʊl}_{\sigma}] \gg *\text{oʊ} \gg$ IDENT.

(2) The predictable [ou] of *pole* does not survive in *pol-ar* (as in *polar weather*) because *polar* is a **stem-level** form. Accordingly, when you combine the nonanalytically listed base *p*/ou/*le* with the adjectival suffix *-ar*, and you submit the derived adjective to the stem-level constraint hierarchy $*\text{ʌʊl}_{\sigma}] \gg *\text{oʊ} \gg$ IDENT, what happens is that *p*/ou/*le*+*ar* becomes *p*[ʌʊ].*lar* (§40(b)). Chung's Generalization is thus respected. (Of course, once a speaker hears or produces *p*[ʌʊ].*lar* for the first time, she immediately stores it nonanalytically in her lexicon, but this is irrelevant for our current purposes.)

(3) In contrast, the predictable [ou] of *poll* does survive in *poll-er* 'person who does polls' because *poller* is a **word-level** form. Accordingly, the combination of *p*/ou/*ll* with the agentive suffix *-er* is not submitted to the stem-level constraint hierarchy that we saw above. Rather, *p*/ou/*ll*+*er* goes through the word-level hierarchy, where IDENT dominates *ou.

In this light, Chung's Generalization should be unpacked as follows:

(4) (i) Chung's Generalization forbids the opaque transmission of allophonic properties from a base to a stem-level derivative.
Example: *p*[ou]*le* ~ *p*[ʌʊ]*lar*.

(ii) Chung's Generalization allows the opaque transmission of contrastive properties from a base to a stem-level derivative.
Example: *m*[ɛ́]*trical* ~ m[ɛ̀]*tricálity* (cf. *m*[í·]*tre* and *c*[ì·]*tológical*: see §10 and §32).

(iii) Chung's Generalization allows the opaque transmission of allophonic properties from a base to a word-level derivative.
Example: *p*[ou]*ll* ~ *p*[ou]*ller*.

Nota bene. Saying that Chung's Generalization 'forbids this' or 'allows that' does not mean that it is a principle of grammar. It is an empirical generalization that is explained by the interaction of independent postulates, including the markedness and IO-faithfulness technology of OT, and the nonanalytic listing of stem-level forms.