

Phonology is cyclic; cyclicity is emergent.

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CYCLICITY AND STRATIFICATION

What this paper aims to contribute to the meeting

§1 Unlike most of the participants at this meeting, I have no expertise either in first-language attrition or in second-language acquisition (you've been warned!), *but* work in these fields is beset with the same foundational problems as pervade the whole of linguistics and cognitive science:

- the controversy between $\left\{ \begin{array}{l} \text{formalism (rationalism)} \\ \text{functionalism (empiricism)} \end{array} \right.$
- the division of labour between $\left\{ \begin{array}{l} \text{theories of grammar (Marr's 1982 computational level)} \\ \text{models of processing (algorithmic and hardware levels)} \end{array} \right.$

An issue for *all* linguists: how can we bridge these gaps?

§2 A case study from morphophonology: the phonological cycle.

- *Deeply explanatory...*

The phonological cycle accounts for a wide range of phenomena, including facts in realms that have not been central to the formalist agenda: e.g. sociolinguistic variation, diachronic change.

- *...but itself emergent?*

But this paper argues that at least one type of phonological cyclicity (stem-level cyclicity) itself emerges from more basic facts, some of which are captured by
and models of processing (blocking in dual-route race models of morphology)
and usage-based theories of grammar (the rôle of frequency)

§3 Methodological lessons

- Incorporating insights from processing models and usage-based theories into formal research can increase empirical adequacy and reduce the need to postulate innate domain-specific knowledge.
- But we still need formal research to tell us what computational properties should emerge from our models of processing and use.

The phonological cycle

§4 The basic idea:

Certain constituents in the morphosyntactic structure of a linguistic expression define phonological domains. This results in a hierarchy of nested domains, where phonology applies iteratively from smaller to larger domains.

E.g. Chomsky et al. (1956: 75), Chomsky and Halle (1968: 20), etc.

Below I give a classic example from stress assignment in present-day English.

§5 *Abracadabra Rule*

In a sequence of three pretonic light syllables, secondary stress falls on the initial syllable:

i.e. $[\omega \text{ } \acute{\sigma}\acute{\sigma}\acute{\sigma}\acute{\sigma}\dots \rightarrow [\omega \text{ } \grave{\sigma}\grave{\sigma}\grave{\sigma}\acute{\sigma}\dots$

e.g. *àbracadábra, dèlicatèssen, mèditerránean, càtamarán.*

§6 Systematic exceptions to the Abracadabra Rule:

base	suffixal derivative	
$[\omega \text{ } \acute{\sigma}\acute{\sigma}\dots$	$[\omega \text{ } \grave{\sigma}\grave{\sigma}\acute{\sigma}\acute{\sigma}\dots$	$*[\omega \text{ } \grave{\sigma}\grave{\sigma}\acute{\sigma}\acute{\sigma}\dots$
<i>Elízabeth</i>	<i>Elizabéthan</i>	<i>*Èlizabéthan</i>
<i>imáagine</i>	<i>imàginátion</i>	<i>*ìmaginátion</i>
<i>orìginal</i>	<i>orìginálity</i>	<i>*òriginálity</i>

§7 Cyclic derivation

Stress applies in two cycles: one over the base stem, the other over the derived stem. The foot-head assigned in the first cycle is carried over into the second cycle, blocking the Abracadabra Rule.

morphological structure $[\text{N} [\text{V } \textit{imagine}] \textit{ation}]$

phonological domains $[[[\text{Imædʒi}]\text{eɪfən}]$

first cycle Σ
 $\text{I.}(mæ.dʒi)\langle n \rangle$

second cycle Σ_w Σ_s
 $\text{I.}(mæ.dʒi.)\langle \text{neɪ} \rangle \langle fən \rangle$

There is a massive literature on this phenomenon, going back to Chomsky and Halle (1968). See Collie (2007) for a detailed recent survey.

THE EXPLANATORY POWER OF THE CYCLE

Classic formal arguments

§12 The cycle outperforms competitors such as the theory of output-output correspondence (e.g. Benua 1997) in correctly predicting key facts about morphology-phonology interactions.

Some examples:

- locality (Orgun 1996b, Kiparsky 1998)

e.g.	derivative	proximate base	remote base
	<i>imàginátion</i> , * <i>ìmaginátion</i>	<i>imáginé</i>	<i>ímage</i>
	<i>orìginálicity</i> , * <i>òoriginálicity</i>	<i>orìginál</i>	<i>óorigin</i>

- unity of alternating and nonalternating opacity (Kiparsky 2000, Bermúdez-Otero 2003)

e.g.	<i>writ-er</i>	<i>mitre</i>
	[_{PL} [_{WL} [_{SL} <i>ɹait</i>] _ɹ]]	[_{PL} [_{WL} [_{SL} <i>maitɹ</i>]]]
stem level (Canadian Raising)	<i>ɹait</i>	<i>maitɹ</i>
word level	<i>ɹaitɹ</i>	—
phrase level (Flapping)	<i>ɹairɹ</i>	<i>mairɹ</i>

- syntagmatic determination (Trommer 2006, Bermúdez-Otero 2007a)

e.g. Albanian deponent verbs have the same pattern of morphologically conditioned stress as normal verbs, even though they lack morphologically active forms.

- etc.

But the cycle can also account for evidence that has traditionally not been at the centre of the formalist agenda.

The argument from variation

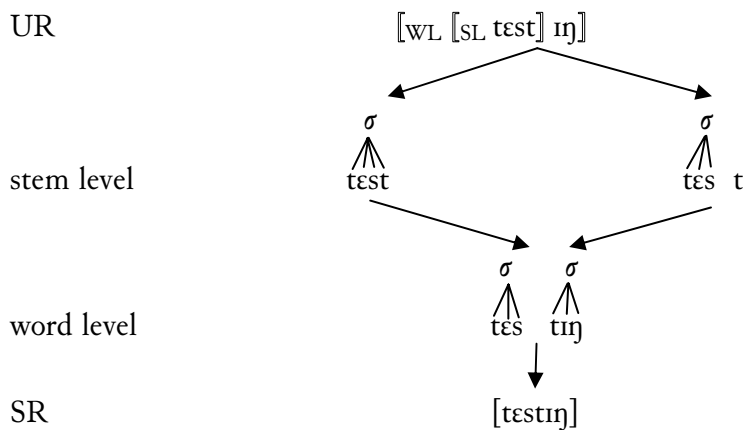
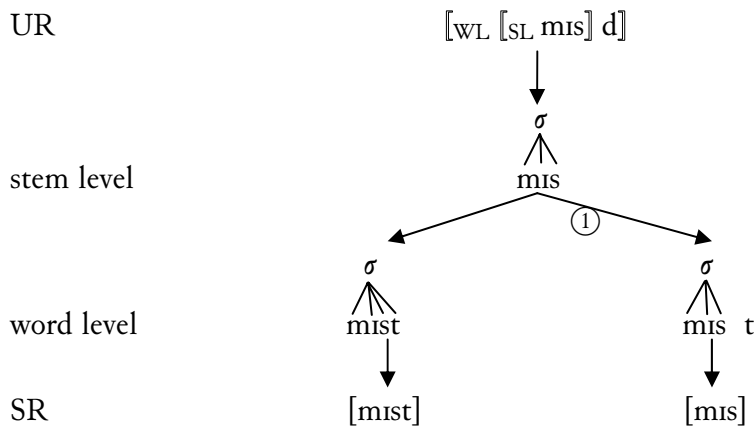
§13 Rate of *t/d*-deletion in Philadelphia English (Guy 1991b, Guy 1991a)

monomorphemic item	<i>mist</i>	38%
irregular (stem-level) weak verb	<i>kep-t</i>	34%
regular (word-level) weak verb	<i>miss-ed</i>	17%

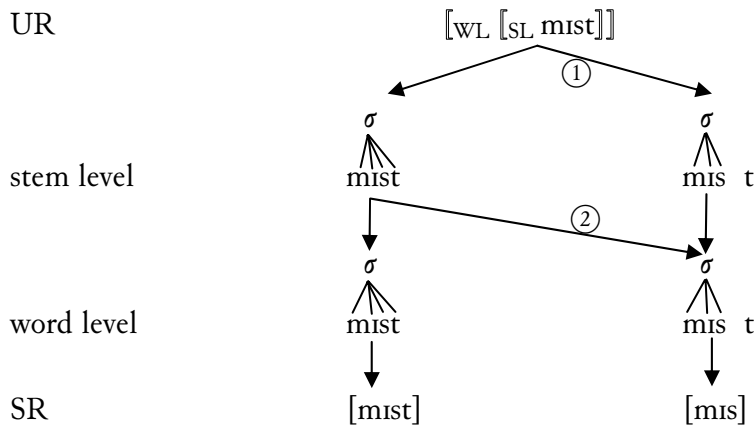
A robust generalization across dialects: see Coetzee (2008: 2) and references therein.

§14 Cyclic explanation:

- The deletion of /t/ and /d/ involves the variable failure of the target segments to be syllabified into complex codas; tokens of /t/ and /d/ that remain unsyllabified at the end of the derivation undergo stray erasure.
- ☞ The greater the number of cycles in which /t/ or /d/ are targeted by desyllabification, the greater the deletion rate.

§15 Desyllabified /t/ rescued in *test-ing* → no deletion§16 One round of desyllabification in *miss-ed* → low deletion rate

§17 Two rounds of desyllabification in *mist* → high deletion rate



The argument from change

§18 Postnasal /g/ deletion in the history of English

$g \rightarrow \emptyset / \eta _ \sigma$ In the syllable coda, /g/ deletes after [ŋ] e.g. *long~~g~~*
 /g/ does not delete in the onset, e.g. prevocally e.g. *finger*

§19 Historically, the process of postnasal /g/ deletion has climbed from the phrase level through the word level up to the stem level; concomitantly, it has become applicable in progressively smaller domains (Bermúdez-Otero 2006: 504, Garrett and Blevins forthcoming: §1)

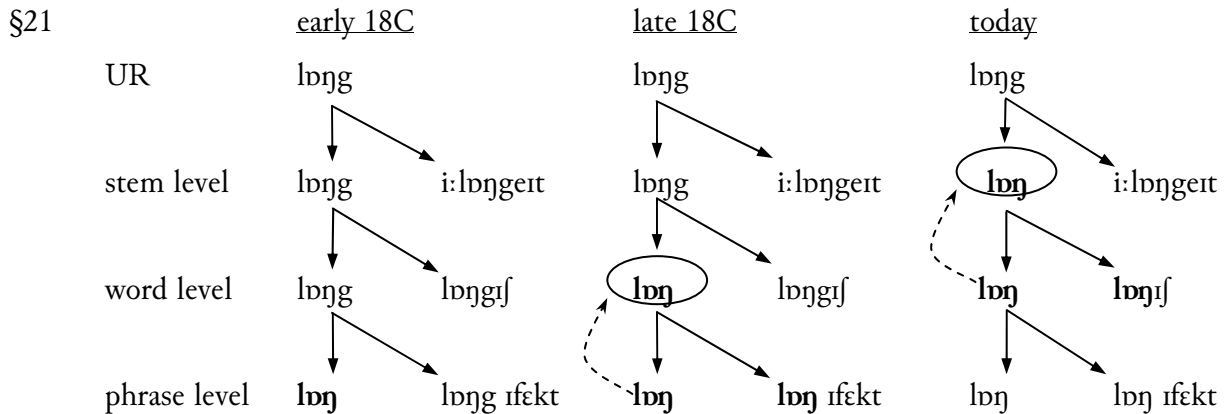
/g/ followed by V ...		early 18C	late 18C	today
... in stem-level domain	[PL [WL [SL e-long-ate]]]	<i>elongate</i>	<i>elongate</i>	<i>elongate</i>
... in word-level domain	[PL [WL [SL long] -ish]]	<i>longish</i>	<i>longish</i>	<i>longgish</i>
... in phrase-level domain	[PL [WL [SL long]] effect]	<i>long effect</i>	<i>longg effect</i>	<i>longg effect</i>
... nowhere	[PL [WL [SL long]]]	<i>longg</i>	<i>longg</i>	<i>longg</i>
		↓	↓	↓
Level at which postnasal /g/ deletion applies		PL	WL	SL

☞ An example of the characteristic life cycle of phonological processes (Baudouin de Courtenay 1972[1895], Kiparsky 1988, McMahon 2000, Bermúdez-Otero 2007b).

§20 Cyclic explanation:

- Analogical change involves the restructuring of input representations in acquisition.
- Children acquire stratified grammars from the bottom up, successively projecting the input to stratum *n* from the input of the lower stratum *n+1*

See Bermúdez-Otero (2003), Bermúdez-Otero and Hogg (2003: §2ff.), Bermúdez-Otero (2006: 501ff.), and references therein.



THE EMERGENCE OF STEM-LEVEL CYCLICITY

A puzzle

§22 Stratum-internal cyclicality in classic rule-based Lexical Phonology:

- Stem level ('level one'): internally cyclic
every stem-level category defines a cyclic domain
e.g. $[_{SL} [_{SL} [_{SL} \textit{origin}] \textit{al}] \textit{ity}]$ see §7 and §12 above
- Word level ('level two'): internally noncyclic
only the outermost category defines a cyclic domain
e.g. $[_{WL} [_{SL} \textit{memory}] \textit{less-ness}]$ see §10 above

E.g. the cyclic and postcyclic levels in Booij and Rubach (1984, 1987), Kiparsky (1985), etc.

This is empirically correct (Bermúdez-Otero forthcoming: ch. 2, *pace* Orgun 1996a)
but conceptually arbitrary.

§23 My proposal:

- All levels are internally noncyclic.
- Effects equivalent to internal cyclicality at the stem level are reflections of special properties of stem-level morphology.
- These effects arise whenever three ingredients are simultaneously present:
 - (i) *Nonanalytic listing of stem-level outputs*
Phonological output representations generated by the stem-level phonology are stored in the permanent lexicon.

- (ii) *Morphological blocking*
A lexically listed item blocks the online grammatical derivation of a competitor.
- (iii) *High-ranking faithfulness*
High-ranking faithfulness preserves some phonological property of inputs.

First proposed by Bermúdez-Otero and McMahon (2006: §3.4). Developed in Bermúdez-Otero (forthcoming: ch. 2) and Collie (2007).

Nonanalytic listing

§24 Lexical listing does not have phonological consequences if the internal domain structure of the listeme remains visible to the phonology:

- Syntactic idioms must be listed in the permanent lexicon because their meaning is not fully compositional

e.g. *pull* [_{POSSP} X] *leg* ‘tease [X]’

- But syntactic idioms have internal structure in the morphosyntax and, *a fortiori*, in the phonology

e.g. wh-movement *Whose leg_i are you trying to pull t_i?*

- A less trivial example:

*scholarship*₁ [[SCHOLAR]PROPERTY]

e.g. *His scholarship₁ deserted him and he was unable to answer like a scholar.*

*scholarship*₂ [EDUCATIONAL GRANT]

e.g. *His scholarship₂ was withdrawn but he remained a hard-working scholar.*

Although *scholarship*₂ must be listed in the permanent lexicon, to my knowledge this has no phonological consequences. The phonology sees the same domain structure as in *scholarship*₁: a word-level (i.e. ‘level-two’) category based on a stem, rather than a stem-level (i.e. ‘level-one’) category based on a root.

[[SCHOLAR]PROPERTY]	[EDUCATIONAL GRANT]	—
[_{STEM} [_{STEM} <i>scholar</i>] <i>ship</i>]	[_{STEM} [_{STEM} <i>scholar</i>] <i>ship</i>]	*[_{STEM} [_V <i>scholar</i>] <i>ship</i>]
[_{WL} [_{SL} <i>scholar</i>] <i>ship</i>]	[_{WL} [_{SL} <i>scholar</i>] <i>ship</i>]	*[_{SL} <i>scholarship</i>]
<i>schólarship</i>	<i>schólarship</i>	* <i>schólársship</i>

In this instance, as in the case of *pull* [_{POSSP} X] *leg*, semantic noncompositionality does not reflect root-based derivation: cf. Marvin (2002), Arad (2003), Embick and Marantz (2008: 11).

Lexical listing has phonological consequences when it is ‘nonanalytic’ (Kaye 1995), i.e. when the lexical entry contains a phonological representation with no internal domain structure.

§25 Postulate: ✎ stem-level constructions are listed nonanalytically.

At present I do not have an exhaustive account of why this postulate should hold true, but I note the following points:

- (i) The postulate leads to the right predictions (§27ff.).
- (ii) Ascription to the stem level is highly correlated with listedness according to criteria other than semantic noncompositionality (cf. §24):

notably, constructions that are ‘nondefault’ and therefore listed by the criteria of Pinker and Prince (1994) and Pinker (1999) typically invoke the stem-level phonology.

E.g. a diachronic instance in Modern Hebrew (Meir 2006):

nondefault morphology	>	stem-level phonology
default morphology	>	word-level phonology

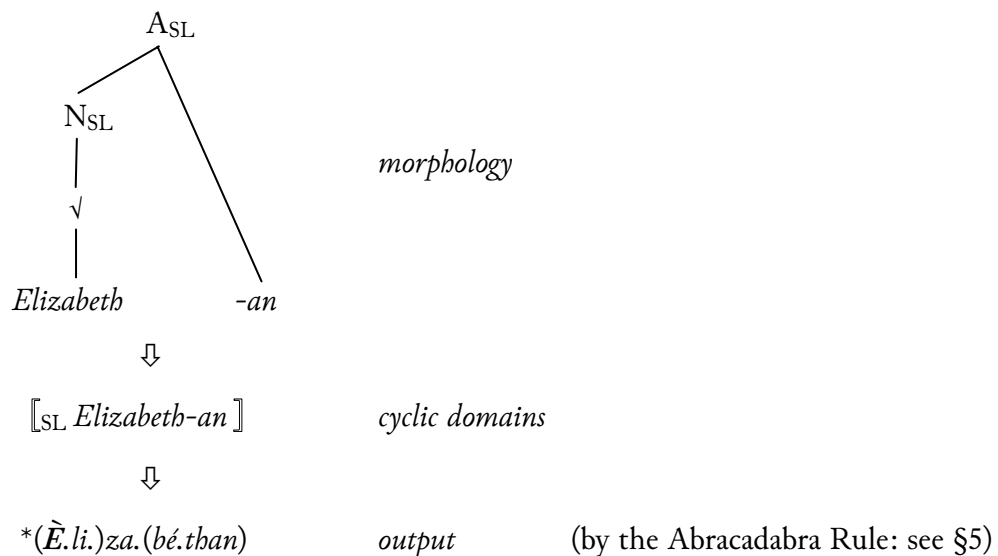
§26 N.B. listed nonanalytically ≠ synchronically inert

If stem-level outputs are listed nonanalytically, then stem-level morphological and phonological processes work as ‘lexical redundancy rules’ in the sense of Jackendoff (1975):

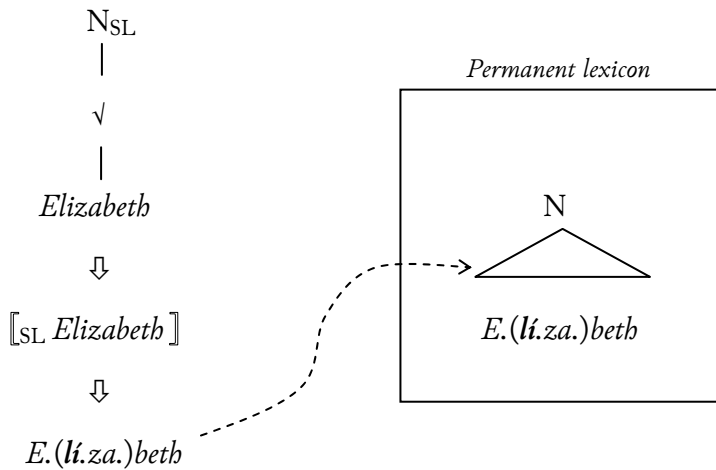
- they redundantly capture relationships between stored items;
- they apply online to generate novel items.

From nonanalytic listing to stem-level cyclicity via blocking

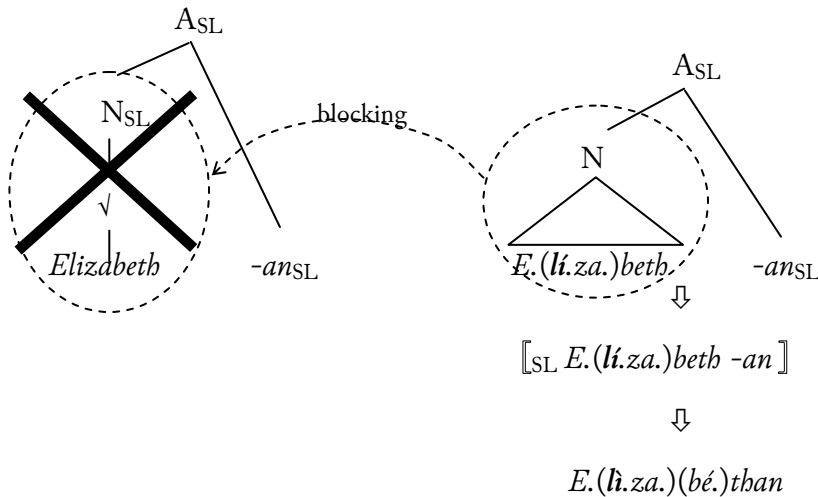
§27 Assume that the stem-level is internally noncyclic. Then,



§28 Now assume nonanalytic listing. Then,



§29 Now, by morphological blocking,



Predicting frequency effects



§30 The success of blocking depends on token frequency.

This is presumably because high token frequency raises resting activation, which in turn increases speed of retrieval, which in turn affects the outcome of the race between lexicon and grammar.

(Aronoff and Anshen 1998: 240 and references therein; see also Hay 2003)

§31 Therefore, if internal cyclicity at the stem level emerges from blocking, then it too should vary according to token frequency.

This is correct:

- low-frequency base high-frequency derivative
inf[ɔ:]rm (286) *inf[ə]rmátion* (38327) } blocking more prone to failure
conv[ɔ:]rse (13) *conv[ə]rsátion* (5169) } cyclic effect less likely 
- high-frequency base low-frequency derivative
adv[æ]ntage (7220) *adv[æ]ntágeous* (372) } blocking less prone to failure
auth[é]ntic (824) *auth[ε]ntícity* (362) } cyclic effect more likely 

Examples from Kraska-Szlenk (2007: §8.1.2), with figures from the BNC . See Collie (2007) for extensive testing and for criticism of a different report in Hammond (2003).


§32 This approach can cope with countercyclic effects, which are intractable in classic Lexical Phonology:

- e.g. in idiolects with *c[ai]cle ~ c[i]clíc ~ c[ai]clícítý*
 stored *c[i]clíc* fails to block *c[ai]cl-íc-ítý*
 (I have observed this paradigm in the speech of my former colleague Dr John Hutton.)


Cyclic approaches to phonology can incorporate insights from usage-based models of grammar (e.g. the rôle of frequency).

The rôle of faithfulness

§33 In an OT-based cyclic model, a property of a listed input will be preserved in the output only if the relevant faithfulness constraint is ranked high at the stem level:

/E(líza)beth-an/ (see §31)	IDENT-FootHead	ALIGN(ω ,L; Σ ,L)
(Èli)za(bé)than	*!	
E(líza)(bé)than 		*

§34 However, by Richness of the Base, this entails that prespecified foot-heads in the UR of monomorphemic items can also block the Abracadabra Rule:

/apótheosis/	IDENT-FootHead	ALIGN(ω ,L; Σ ,L)
(àpo)the(ó)sis	*!	
a(pòthe)(ó)sis 		*

Prediction independently derived in Bermúdez-Otero and McMahon (2006: 400) and in Kiparsky (2007).

§35 Thus, Chung's Generalization is derived as a theorem:

☞ *Chung's Generalization*

If a stem-level phonological generalization displays cyclic misapplication, then it also has lexical exceptions.

I propose the label 'Chung's Generalization' in recognition of the pioneering insight of Chung (1983: 63). In Stratal OT, this theorem supersedes Structure Preservation, which is demonstrably wrong: see Bermúdez-Otero (forthcoming) for details.

Conclusion

§36 Stratum-internal cyclicity at the stem level need not be stipulated, but can be derived from plausible independent assumptions (with a concomitant increase in empirical adequacy, as shown in §30-§32).

In this respect, therefore, a cyclic approach to the morphology-phonology interface is compatible with an abstractness-without-innateness programme for linguistic theory.

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