Nonanalytic listing and the theory of the stem level

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INTRODUCTION: THE STEM-LEVEL SYNDROME REDUX

The story so far

§1 Session ❶ posed the challenge of explaining the unique propensity of stem-level phonological processes (both prosodic and segmental) to exhibit unbounded cyclic reapplication.

Examples up to now:  
• Armenian high vowel deletion  ❄§16  
• English stress assignment  ❄§17  
• English trochaic shortening  ❄§18  
• Spanish high vocoid syllabification  ❄§19  
• English /aʊ/-raising  ❄§11-§26

§2 Session ❶ briefly outlined a theory of the stem-level syndrome consisting of three elements (Bermúdez-Otero 2012: 26-39, 2013b):

(i) Optimality-theoretic computation  
• The cyclic transmission of phonological properties requires high-ranking input-output faithfulness in the relevant cycles;  
• in turn, high-ranking IO-faithfulness at the stem level entails a relationship of mutual implication between cyclic reapplication and constrastivity (Chung’s Generalization).

(ii) Nonanalytic listing  
• If the stem-level output representation of a base is stored,  
• then its stem-level properties will (when protected by high-ranking faithfulness) be cyclically transmitted to other complex stem-level forms derived from it online.

(iii) A dual-route race model of processing  
• Cyclic reapplication effects emerge only when the online derivation of complex stem-level forms wins in the production race over the lexical retrieval of inherited noncyclic forms;  
• therefore, cyclic reapplication effects spread historically by lexical diffusion and are sensitive to lexical token frequency.

We saw that, surprisingly, /aʊ/-raising in Mississippi supported this theory (❄§11-§26).

Refining the theory

§3 OT and Chung’s Generalization

(i) English stress assignment and /aʊ/-raising illustrate the positive version of Chung’s Generalization: i.e. contrastivity ↔ cyclicity.

(ii) But the negative version of Chung’s Generalization predicts that  
• there exist stem-level processes that enforce purely allophonic distributions over underived items,  
and  
• such processes do not show cyclic misapplication in complex stem-level derivatives,  
even if they misapply in word-level forms, giving rise to derived contrasts.  
This prediction is confirmed by evidence from /au/-allophony in the London vernacular.

§4 Analytic and nonanalytic listing

(i) The nonanalytic listing of bases suffices for a storage-driven account of cyclic misapplication effects in stem-level derivatives.

(ii) The nonanalytic listing of those bases can often be independently motivated with evidence from semiprodutictivity, semantic noncompositionality, and phonological idiosyncrasy.

(iii) Stratal analyses often assign highly productive and transparent affixes—notably including some inflectional markers—to the stem level, but this is unproblematic insofar as those affixes are peripheral in stem-level domains.

(iv) In a fully articulated theory of the stem level, therefore,  
• splits between stem-level and word-level affixation emerge diachronically from historical changes which narrow down the domains of phonological processes (❄❼);  
• nonanalytic listing is responsible only for cyclic reapplication effects.

(v) In turn, factors such as noncompositionality also often require the storage of word-level and even phrase-level constructs. Still,  
• the word and phrase level remain internally noncyclic because the relevant expressions are listed analytically;  
• the existence of analytic listing is independently motivated by psycholinguistic evidence (e.g. word-level forms exhibit surface frequency effects, and yet prime their bases as effectively as the identity prime).

§5 Dual-route race processing in history

(i) Stem-level cyclic misapplication exhibits effects of lexical token frequency because it arises when lexical retrieval loses to online derivation from a based stored nonanalytically.

(ii) However, the size of such frequency effects will be alternation-specific because phonetic factors in sound change exert a separate effect on the historical transmission of cyclic forms.
THE ROLE OF OT: CHUNG’S GENERALIZATION AND ITS NEGATIVE VERSION

§6 An instance of cyclic reappllication: English stress assignment

<table>
<thead>
<tr>
<th>underven item</th>
<th>derived item</th>
</tr>
</thead>
<tbody>
<tr>
<td>[\textit{abracadabra}] [\omega (\textit{a.bra}).(\textit{d.bra})]]</td>
<td>[\textit{imagine}] [\omega (\textit{m.ig}).(\textit{n.ige})]]</td>
</tr>
</tbody>
</table>

§7 In OT, cyclic inheritance requires high-ranking faithfulness:

\[
\begin{array}{c|c|c}
\text{cycle} & \text{stress} & \text{alignment} \\
\hline
1^\text{st} & \text{IDENT} & \Rightarrow L;L \\
2^\text{nd} & \text{IDENT} & \Rightarrow L;L \\
\end{array}
\]

§8 In Stratal OT, high-ranking faithfulness at the stem level entails contrast.

The prediction proves correct: regular \textit{abracadabra} contrasts with exceptional \textit{apēboxiēs}

§9 Chung’s Generalization: the positive version (\(\varphi \leftrightarrow \psi\))

The statement in §9 is logically equivalent to

- cyclic preservation in stem-level derivatives
- contrast in underived items

§10 Chung’s Generalization: the negative version (\(\neg \varphi \leftrightarrow \neg \psi\))

The negative version of Chung’s Generalization creates a crucial difference between

- rule-based Lexical Phonology
- constraint-based Stratal Phonology

In rule-based Lexical Phonology, all stem-level processes are claimed to be

- cyclic
- structure-preserving (i.e. non-allophonic)
- blocked in non-derived environments

In constraint-based Stratal Phonology, there are predicted to exist stem-level processes which

- apply allophonically (creating complementary distributions) in underived items,
- apply across the board (exhibiting no cyclic effects) in complex stem-level forms,
- misapply in word-level expressions, creating morphologically derived contrasts.

Constraint-based Stratal Phonology wins: its prediction is confirmed by London /\textit{əʊ}/-allophony. For more examples, see Bermúdez-Otero (2013b: §23).

§11 The process

Within stem-level domains,

\[
\begin{array}{c|c|c}
\text{underived} & \text{derived} \\
\hline
\text{\textit{\textbf{GOAT}}-split} & \Rightarrow L;L \\
\text{\textit{GOAT} vowel} = \text{the phoneme /\textit{əY}/ in Wells’s lexical-set terminology (1982: 146-147).} \\
\end{array}
\]

The literature again (\(\text{\textit{\textbf{GOAT}}-split}\))

§14 The environment for retracted [ʊ] is sometimes stated as 
rather than 
This is likely to have been true of the process in its incipient diachronic stage. 
Synchronically, however, Southern British English speakers often show retracted back-vowel allophones before surface light [l]: e.g. unfronted [u] before light [l] in fool-ing (speaker YF8 in Strycharczuk & Scobbie 2016: 83)

§15 The process is allophonic

Perfect complementary distribution in underived items:

e.g. [ʊ] — [l] — [ɪv...]

coal, coley 'type of fish'
hole
roll
Roland
pol, poll

§16 The process is stem-level

Cyclic overapplication of retraction when the following /l/ is resyllabified into the onset before a vowel-initial word-level suffix ⇒ 'derived contrast' in the sense of Harris (1990):

° e.g. [ʊ] coal-ly 'coal-like' cf. [ʊ] in cola, coley
hol-ey 'full of holes' boly 'sacred'
roll-er, roll-ing Roland
pol-er, poll-ing

Derivation:

poll-er
domains [wl, st, poll] a]
° (allophony) .poll. retraction before tautosyllabic [l]
° (faithfulness) .poll.l. resyllabification

§17 No cyclic misapplication in stem-level derivatives

° e.g. [ʊ] Mongol-ian
Walpole-ian
pol-ar
° like coley, boly

pol-er
° cf. [ʊ] in pole and poll-er

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

‡ The negative version of Chung's Generalization (§10) is confirmed!

§18 Analysis

(i) Stem-level grammar: *pol-er] ≫ *bu] ≫ IDENT markedness dominates
(ii) Word-level grammar: IDENT ≫ *bu faithfulness dominates

§19 High-ranking markedness at the stem level enforces complementary distribution in underived items (see §15):

(i) retraction

(ii) fronting

§20 High-ranking faithfulness at the word level enforces cyclic overapplication of retraction (see §16):

§21 High-ranking markedness at the stem level triggers flip-flopping derivations in stem-level derivatives, resulting in complementary distribution within complex stem-level forms (see §17):

Derivation:

pol-ar
domains [st, s, poll] a]
( (allophony) .poll. retraction before tautosyllabic [l] .poll.l. fronting

(i) 1st cycle: retraction

(ii) 2nd cycle: fronting
/əY/-retraction cannot be word-level.

§22 Prosodic bounding analysis (e.g. Szpyra 1989: 178-200, Hammond 1999, Raffelsiefen 2005)

retraction before tautosyllabic /l/: /əY/ → [əl]

but word-level suffixes adjoin under ω’: pole/poll pol-ar pol-er

and ω-boundaries block resyllabification (ω′.pol.l.ω′.pol.l.a.)

Objection: this prosodification is inconsistent with the phonetic data on preboundary lengthening (Bermúdez-Otero 2011: §4).

§23 Extrinsic rule-ordering analysis (cf. Kiparsky 1985: 91)

retraction before tautosyllabic /l/: /əY/ → [əl] (word level)

domains pole/poll pol-ar pol-er

ό.ο 1st cycle .pol. .pol. .pol.

ό.ό 2nd cycle .pol.l. .pol.l. .pol.l.a.

ό.ο 3rd cycle .pol.l. .pol.l. .pol.l.a.

resyllabification — — —

/əY/-allophony [pol.l.]

Objections: • devalues the concept of cyclic domain;
• requires a very powerful learning theory.

§24 Direct reference to brackets (see Harris 1990: 98; also Mohanan 1982: 121 and Halle & Mohanan 1985: 96)

retraction before base-final /l/: /əY/ → [əl] (word level)

domains pole/poll pol-ar pol-er

ό.ό 1st cycle [.pol.l.] [.pol.l.] [.pol.l.]

ό.ό 2nd cycle [.pol.l.][ .pol.l. a.]

Bracket Erasure† — —

ό.ό input [.pol.l.] [.pol.l.] [.pol.l.]

resyllabification — — —

/əY/-allophony [.pol.l.] [.pol.l.] [.pol.l.]

† Internal brackets erased at the end of each stratum (Kiparsky 1982a: 140; cf. SPE: 20).

Objection: misses a generalization, since we still need /əY/-retraction before tautosyllabic non-base-final /l/

e.g. poultry [pʊl.tɪ], *[pʊl.tɪ]

no bracket follows /l/ in the WL-input [.pʊl.tɪ]
§29 The insight in general form:

Cyclic misapplication can occur within a stem-level derivative if its base is stored nonanalytically.

Independent evidence for the nonanalytic listing of stem-level derivatives

§30 Many a stem-level derivative must have its own lexical entry because its semantics is not fully compositional:

- *edit-or* → *edit-orial* 'pertaining to the editor'
- *globe* → *glob-al* 'Earth-wide'

Noncompositionality is prevalent among deradical items (Marvin 2002, Arad 2003, Embick & Marantz 2008), which are always stem-level; but it is not limited to such items (e.g. Marantz 2013).

§31 Similarly, many a stem-level derivative must have its own lexical entry because it is the output of a semiproductive morphological process,

and therefore the outputs of the process that do exist must be listed in the lexicon:

E.g.

a. commit
   
   OED entry? | commission | committal | committance
   tokens per 10^6 words in BNC | 112.04 | 2.65 | 0
b. permit
   
   OED entry? | permission | permittal | permittance
   tokens per 10^6 words in BNC | 33.84 | 0 | 0
c. submit
   
   OED entry? | submission | submittal | submittance
   tokens per 10^6 words in BNC | 15.66 | 0 | 0

† Frequent in American English, but only as the nominalization of transitive *submit* (as in submit an application); cf. intransitive submit to authority.

Data from Bermúdez-Otero (2012: 26). For the general principle, see e.g. Jackendoff (1975) and Jackendoff & Audring (2018: 11-12, 14).

§32 The semantic noncompositionality (§30) and semiproductivity (§31) of stem-level constructions requires that a great many stem-level forms should have their own lexical entries.

In turn, phonological idiosyncrasy requires that those lexical entries should be nonanalytic:

- *acrob-at* ~ *acrob-atic*
- *atom* ~ *atom-ic*
- *idyll* ~ *idyll-ic*
- *metal* ~ *metall-ic*
- *titan* ~ *titan-ic*
- etc

but cf. exceptional *Arab* ~ *Árab-ic* *Catholic* ~ *Cátol-ic*.

On stem-level inflection

§33 Many stratal analysis require that highly productive, semantically transparent affixes—including inflectional markers—should be affiliated to the stem level:

- Arabic subject-agreement markers (Kiparsky 2000)
  
  criterion: interaction between stress assignment and high vowel deletion
- Spanish verbal inflection (Bermúdez-Otero 2013a, and §19, §26)
  
  criterion: interaction between stress assignment and mid vowel diphthongization

It is implausible to argue that all forms containing such affixes are listed.

Q. Is this a problem?

§34 A. No! These affixes occupy peripheral positions within stem-level domains;

the relevant cyclic misapplication effects only require the nonanalytic listing of their bases (see §27, §29).

E.g.

- Arabic stratification (Kiparsky 2000: 359)
  
  *he understood* *he understood us* *we understood*

<table>
<thead>
<tr>
<th>domains</th>
<th>[wː [sː fiːm] [wː [sː [sː fiːm] na]]</th>
<th>[wː [sː [sː fiːm] na]]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st cycle</td>
<td>fiːm</td>
<td>fiːm</td>
</tr>
<tr>
<td>2nd cycle</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

In this type of situation, only the inner stem, viz. (*sː fiːm*), need be stored nonanalytically;
the correct stratal-cyclic effects would emerge even if the outer stem-level affix, viz. 1PL.SBJ ~ *naːsː*, always attached online.
Different causal mechanisms for stratal splits and for stem-level misapplication

§35  
(i) In sum, cyclic misapplication effects within forms derived at the stem level occur because the lexicon contains an inner core of stem-level expressions subject to nonanalytic listing (§30-§32):

- deradical forms
- semiproductive, not fully compositional, exception-prone derivation

(ii) This remains the case even while the frontier between stem-level and word-level affixation fluctuates diachronically as a result of diachronic processes of domain narrowing (➋❼) and lexicalization (➋❼).  

§36  
A generic diachronic scenario:

- Inner core of nonanalytically listed forms
- Phonological constraint ranking A
- Stem-level/word-level boundary
- Phonological constraint ranking B
- Grammatical words
- Phonological constraint ranking C

Stage 1

<table>
<thead>
<tr>
<th>Domain Narrowing</th>
<th>Analytic Storage</th>
</tr>
</thead>
</table>
| ØA undergoes domain narrowing | E.g. Analytic storage of German word-level ein-ig [ae.nçi] 'united / unanimous':
| ØA dies of lexicalization | E.g. (ae.nçi)-襁 |

Stage 2

<table>
<thead>
<tr>
<th>Phonological Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voiceless [çi] is derived at the WL</td>
</tr>
</tbody>
</table>

Stage 3

| ØB undergoes domain narrowing |

§37  
In this scenario,

- endogenous historical processes of domain narrowing introduce splits between stem-level and word-level affixation;
- the location of the boundary between stem-level and word-level affixation varies widely from one synchronic stage to the other, but inner-core items (§35i) are always stem-level;

- within the stem level, the nonanalytic listing of inner-core items causes unbounded cyclic effects (for phonological properties protected by high-ranking faithfulness).

This explains why language after language exhibits a split between the stem and word levels, with each level exhibiting the expected properties (➋❼§15-§20), even though the location of the boundary between the levels varies widely and apparently erratically across languages (➋❼).

Analytic listing

§38  
Word-level and even phrase-level expressions may need to be lexically listed:

- Noncompositional word-level derivatives
  - English scholar-ship noncompositional meaning ('educational grant')
  - but word-level phonology (stress neutral)
  - Dutch and Catalan complex place names (Köhnlein 2015, Mascaró 2016)
  - Dutch Wâgenin-[ə]n reference unpredictable, but word-level phonology (violation of trisyllabic stress window, schwa after stressless syllable)

- Clausal idioms (e.g. Horvath & Siloni 2019)
  - English butter wouldn’t melt in X’s mouth

§39  
Q. Why doesn’t the listing of word- or phrase-level expressions trigger cyclic misapplication?

B. Because such listing, when it occurs, is **analytic**:

- phonological properties derived at the word- or phrase-level are not stored in the lexical entry.

E.g. Analytic storage of German word-level ein-ig [ae.nçi] 'united / unanimous':

Therefore, the representation of DAT.PL ein-ig-en in the input to the word level will be

\[(ae.nçi)-ヴィ-n\]

Hence, no cyclic reapplication of word-level coda devoicing:

[ae.nçi-gn], not *[ae.nçi-ヴィ-n]
§40 Relevant psycholinguistic evidence

(see further Bermúdez-Otero 2013b: §36)

(i) Effects of frequency on recognition speed

• Two measures of frequency:
  e.g. taking
  surface frequency = frequency of taking
  base frequency = frequency of take, takes, took, taking

• General observation:
  higher frequency ⇒ higher recognition speed
  (e.g. Forster & Chambers 1973)

• So... base frequency effect ⇒ evidence for decomposition
  surface frequency effect ⇒ evidence for own entry in the lexicon
  (e.g. Banyen et al. 1997, 2002; but cf. Taft 2004)

(ii) Priming

• Priming: exposure to form a speeds up the recognition of form b

• Full priming:
  e.g. German Waggon-‘s ‘train_carriage-PL’ primes Waggon ‘train_carriage[SG]’
  as much as Waggon primes itself (identity priming) (Clahsen et al. 2003)

• Full priming ⇒ evidence for decomposition
  Reduced priming ⇒ evidence for own entry in the lexicon

§41 A psycholinguistic argument for the analytic listing of German -chen diminutives

German inflection and derivation (Clahsen et al. 2003)

<table>
<thead>
<tr>
<th>Type of item</th>
<th>Full priming?</th>
<th>Surface frequency effect?</th>
</tr>
</thead>
<tbody>
<tr>
<td>regular -s plural:</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>e.g. Waggon-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>diminutive: e.g. kind-chen</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>irregular -er plural:</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>e.g. kind-er</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Recall that full priming ⇒ evidence for decomposition (§40i)

surface frequency effect ⇒ evidence for own entry in lexicon (§40i)

Solution: a decomposed (analytic) entry KINDCHEN ↔ /kindər/ˌkan/
§44 The effect of lexical token frequency

Noncyclic stress is more likely when the base has relatively low token frequency (§3.3.3):

<table>
<thead>
<tr>
<th></th>
<th>base tokens per millions words in spoken section of COCA</th>
<th>derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. cyclic stress</td>
<td>con[3][n]en  cond[3][n]-ción</td>
<td>7.09</td>
</tr>
<tr>
<td></td>
<td>imp[3][r]t     imp[3][r]-ción</td>
<td>5.15</td>
</tr>
<tr>
<td>b. variable stress</td>
<td>cond[3][n]se  cond[3][n]-sión</td>
<td>0.28  ≈ 0.22</td>
</tr>
<tr>
<td>c. noncyclic stress</td>
<td>con[3][r]se  con[3][r]-sión</td>
<td>1.65 &lt; 9.11</td>
</tr>
<tr>
<td></td>
<td>tränsp[3][r]t  tränsp[3][r]-ción</td>
<td>7.23 &lt; 23.54</td>
</tr>
</tbody>
</table>

Anecdotal data from Bermúdez-Otero (2012: §3.3.3), based on Kraska-Szlenk (2007: §8.1.2); but the effect has been replicated in rigorous statistical studies:

- see Collie (2007, 2008) on pretonic sequences of the types σσσσσ...and σσσσσ...
  e.g. anticipate ~ anticipa-tion (cyclic) ~ anticipa-tion (noncyclic)
- see Dabouis (2017) on cyclically derived sequences of the type σσσ...
  e.g. collective ~ collectiv-íty (cyclic) ~ collectiv-íty (noncyclic)

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

- probability of non-reapplication: \[ _\sigma^σ \]... e.g. tränsp[s]r-tación, despite tränsp[s]rt
  \[ _\sigma^σ \]... e.g. anticipa-tión, despite anticipate
  \[ _\sigma^σ \]... e.g. dissimila-tión, despite dissimila-tión


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 \[ _\sigma^σ \]... (target syllable relatively long; flanking σ’s headed by reduced vowels)
  worse in \[ _\sigma^σ \]... (target syllable relatively short; flanking σ’s headed by full vowels).

§45 The effect of phonetics

- The foot-head on the second syllable of tränsp/s/r-tación is relatively poorly cued phonetically because the syllable is weaker—and so shorter—than both its neighbours, which are also full-vowelled.
  So: tränsp/s/r-tación has a nonzero chance of being misperceived as tränsp/s/r-tación.

The magnitude of this effect is alternation-specific (§45) because it depends on phonetic cue strength:

- tränsp/s/r-tación runs a greater risk of being misperceived as tränsp/s/r-tación than dissimila-tión does of being misperceived as dissimila-tión.

§46 Both the effect of lexical token frequency (§44) and the effect of perceptibility (§45) can be explained diachronically:

- Assume an initial stage of noncyclic stress: i.e. tränsp[s]r-tación.
- Once the relevant metrical faithfulness constraints are promoted in the stem-level phonology (§3.3.3), forms with cyclic stress, i.e. tränsp/s/r-tación, first appear when online derivation from the nonanalytically listed base, i.e. tränsp/s/r-tación, beats the lexical retrieval of the inherited form tränsp/s/rt-a-tación.
  This assumes a dual-route race model of morphological processing: see Schreuder & Bayen (1995), Baayen et al. (1997), Hay (2003).
- After being produced, the new cyclic forms are nonanalytically listed too.
- Thereafter, the outcome depends on the balance of forces favouring the diachronic transmission of cyclic and noncyclic forms, i.e. tränsp/s/r-tación vs tränsp/s/rt-a-tación.

§47 One mechanism boosts the transmission of tränsp/s/rt-a-tación:

- Whenever on-line derivation from (tränsp/s/rt-a-tión) wins the race against lexical search, the output is (tränsp/s/rt-a-tión).
- The magnitude of this effect depends on...

- In fact, on-line derivation from (tränsp/s/rt-a-tión) 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 §44).

§48 Another mechanism boosts the transmission of tränsp/s/rt-a-tación:

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REFERENCES


