

# Alternation types: computation, storage, history

Ricardo Bermúdez-Otero

(*University of Manchester*)

Brugmann Fellow, IGRA, Leipzig, July 2019

## Course overview

### ABSTRACT

Contextual variation in the form of linguistic exponents, i.e. ‘alternation’ in the broadest sense of the term, comprises an extremely wide variety of phenomena: from probabilistic variation operating over—and affected by—continuous phonetic parameters, to strong suppletion conditioned by syntactic features. This course presents an attempt to derive a fine-grained taxonomy of alternation types in a theoretically principled manner from the interaction of three key elements:

- (i) a constraint-based stratal-cyclic theory of **phonological computation** (Bermúdez-Otero 2018b);
- (ii) an approach to **lexical storage** under which entries may be either nonanalytic or analytic, and may be linked by nonproductive schemata (Bermúdez-Otero 2012: §2.3);
- (iii) an account of the **diachronic life cycle** of phonological patterns (Bermúdez-Otero 2015).

This effort leads to the conclusion that, whilst the synchronic implementation of particular alternations often involves highly complex and redundant interactions between several lexical and grammatical components, the overall typology and diachronic dynamics of alternation presents a remarkably orderly picture at the global level.

### SYLLABUS

❶	4 Jul 5pm	<i>Computation 1</i>	Foundations of Stratal Phonology
❷	8 Jul 1pm	<i>Computation 2</i>	Challenges to Stratal Phonology
❸	10 Jul 5:15pm	<i>Colloquium talk</i>	English /aɪ/-raising: new insights into an old problem
❹	15 Jul 1pm	<i>Storage 1</i>	Nonanalytic listing and the theory of the stem level
❺	18 Jul 1pm	<i>Storage 2</i>	Listed stem allomorphs and via-rules
❻	22 Jul 1pm	<i>History 1</i>	The life cycle of phonological processes and rule scattering
❼	25 Jul 1pm	<i>History 2</i>	Endogenous stratal splits and the life cycle of affixes

## UNIT OVERVIEW

① *Computation 1*

Thu 4 Jul 5pm

**Foundations of Stratal Phonology**

This course sets out to derive a principled and fine-grained taxonomy of alternations from the interaction between phonological computation, lexical storage, and historical change in phonological and morphological patterns. This agenda has roots in early Structuralism (particularly the work of Kruszewski and Baudouin de Courtenay) and in rule-based Lexical Phonology. Today it continues to be pursued within stratal constraint-based frameworks.

The first session surveys the foundations of present-day Stratal Phonology. I first motivate a cyclic approach to the morphosyntax-phonology interface, focusing in particular on striking instances of parallelism between phonological and semantic interpretation. I then address the question of which grammatical constituents define cyclic phonological domains. Decades of accumulated research within the stratal framework furnish abundant examples of three types of phonological process:

- (i) **phrase-level** processes applying across the board within utterances, subject only to prosodic bounding (e.g. Spanish emphatic trilling);
- (ii) **word-level** processes applying across the board within grammatical words, again subject only to prosodic bounding (e.g. Spanish nasal velarization);
- (iii) **stem-level** processes applying within sublexical domains (e.g. Armenian high vowel deletion).

Strikingly, evidence for unbounded cyclic reapplication is largely confined to stem-level processes (e.g. Armenian high vowel deletion, English stress assignment, Spanish high vocoid syllabification). The word level is demonstrably noncyclic (e.g. German devoicing, Indonesian stress) or shows internal cyclicity only in very rare cases of word-to-word derivation (e.g. /l/-vocalization in Brazilian Portuguese diminutives). Puzzlingly, solid evidence for unbounded cyclic reapplication of phrase-level segmental processes is largely absent; the best evidence for phrase-level cyclicity is confined to tonal phenomena, and even in this case some analyses posit cycles over syntactic phrases whilst others posit cycles over prosodic phrases.

This state of affairs raises problems for single-engine accounts of cyclicity like Phase Theory (Embick 2014) or Sign-Based Morphology and Phonology (Orgun 1996). A task carried forward to later sessions in the course is that of accounting for the propensity of stem-level processes to reapply in an unboundedly cyclic fashion (► ③, ④).

Suggested reading: Winters (1993: §3.4), Kaisse & Shaw (1985), Bermúdez-Otero (2010; 2018b: §5.1, §5.2).

② *Computation 2*

Mon 8 Jul 1pm

**Challenges to Stratal Phonology**

In this session I address important phenomena that have been argued to challenge constraint-based Stratal Phonology. I argue that, in every case, independently motivated solutions are available within phonology, morphology, or semantics, and no modification of the interface theory is necessary. These issues thus contrast with problems such as irregular frequency-sensitive stem-level cyclicity (►❸,❹), which do call for innovative solutions within the stratal tradition.

**(i) Stratum-internal opacity**

In constraint-based Stratal Phonology, opaque interactions between phonological processes often emerge without stipulation from the relative sizes of their cyclic domains (e.g. Catalan lexical /z/-affrication and postlexical voicing assimilation). This state of affairs boosts learnability (►❸). Instances of stratum-internal opacity do exist, but they typically submit to analyses that rely on independently motivated constraint types, such as distantial faithfulness constraints, which are required to deal with chain shifts (e.g. Catalan phrase-level spirantization and voicing assimilation). In contrast, the use of extrinsically ordered rules can fatally undermine the concept of cyclic domain, as illustrated by Halle et al.'s (1991) analysis of Spanish mid-vowel diphthongization.

**(ii) Paradigmatic dependence without cyclic containment**

Cyclic frameworks are challenged by situations where the form of an expression *a* determines that of a related expression *b* even though *a* is not contained within *b*. In Romanian, for example, the plural form of a noun determines whether the noun stem undergoes palatalization before the derivational suffix /-ist/, even though the plural of the base is not contained within the derivative (Steriade 2008). I argue that such dependencies are routed through the acquisition of underlying representations: *a*, though not itself contained within *b*, cues the underlying properties of a constituent it shares with *b*. This approach makes correct empirical predictions that the alternatives miss.

**(iii) Bracketing paradoxes**

Apparent mismatches between domains for phonological and semantic interpretation are problematic for any cyclic framework. I tackle two examples. In the case of *ungrammaticality*, I argue in favour of a prosodic solution along the lines of Booij & Lieber (1993): cyclic derivation runs off the grammatical constituency  $[[ungrammatical]ity]$ , but an independently motivated  $\omega$ -boundary blocks nasal place assimilation across the prefix-stem juncture during the stem-level cycle triggered by *-ity*. In cases like *nuclear physicist* and *nuclear physician*, I argue against bracketings like  $[[nuclear\ physi]c]ist$  and  $[[nuclear\ phys]ic]ian$  on morphological, syntactic, and semantic grounds: this includes novel evidence that *physicist* and *physician* are domains for allosemy selection in the sense of Marantz (2013). The paradoxical readings of these expressions are best handled by semantic mechanisms of nonintersective modification of the type that is independently required by cases like *former president*, *wannabe actor*, *alleged murderer*, *habitual thief*, and *beautiful chef*.

- Suggested reading: (i) Kiparsky (2015),  
(ii) Bermúdez-Otero (2018a),  
(iii) Newell (2019), Bermúdez-Otero (2018b: §5.4.2; 2016: §3).

③ *Colloquium talk*

Wed 10 Jul 5:15pm

**English /aɪ/-raising: new insights into an old problem**

So-called ‘Canadian raising’ is a venerable old chestnut of theoretical debate in phonology. In this talk I use it as a parade example of the explanatory power of the approach to alternation set out in this course. In particular, I show how a stratal analysis of English /aɪ/-raising along the lines of Bermúdez-Otero (2003), supplemented with the theory of the stem level in Bermúdez-Otero (2012: 26-39) and the doctrine of the life cycle of phonological processes (Bermúdez-Otero 2007: 503-508; 2015), predicts recent empirical discoveries (Moreton 2016, Davis et al. 2019). The talk introduces topics that are picked up and developed in other sessions of the course:

- (i) Chung’s Generalization (▶④),
- (ii) irregular frequency-sensitive stem-level cyclicity (▶④),
- (iii) the life cycle of phonological processes (▶⑥),

and (iv) the acquisition of opacity (◀②,▶⑥).

Talk abstract: <https://tinyurl.com/y4fjcplp>

- Suggested reading: Chambers (1973), Bermúdez-Otero (2003), Moreton (2016), Davis et al. (2019).

④ *Storage 1*

Mon 15 Jul 1pm

**Nonanalytic listing and the theory of the stem level**

This session presents an articulated theory of stem-level alternations relying on three key ingredients: constraint-based computation, two types of lexical storage, and a dual-route race model of morphological processing (Bermúdez-Otero 2012: 26-39). The key explanandum is why unbounded cyclic reapplication occurs at the stem level, but not at the word level (◀①). The argument proceeds as follows:

I begin by noting that, in an optimality-theoretic framework, cyclic inheritance requires high-ranking input-output faithfulness. In turn, this entails Chung’s Generalization (Bermúdez-Otero 2012: 31, and references therein): if a phonological property is cyclically inherited by stem-level derivatives, then it is contrastive (fully or marginally) in underived items, and vice versa. English /aɪ/-raising (◀⑤) and pretonic stress assignment illustrate this prediction. The negative version of Chung’s Generalization, which is logically equivalent, states that, if a stem-level process applies purely allophonically in underived items, then it does not cyclically reapply within complex stem-

level forms, and vice versa. Of course, such an allophonic stem-level process may nonetheless misapply in word-level forms, creating a derived contrast at the word level. This is illustrated with the Cockney GOAT-split.

I then show that the contrast between the stem and word levels emerges if one assumes that stem-level expressions are stored in the lexicon with their derived properties (**nonanalytically**), whereas word-level expressions are either stored in decomposed format (**analytically**) or not stored at all. I review the psycholinguistic evidence for these two types of storage (recognition latencies, priming, production errors, affix shifts), and explore the probabilistic correlation between low productivity, nonanalytic listing, and stem-level status (►❶). Analytic lexical entries are shown to be independently required to account for the behaviour of complex constructs that are semantically noncompositional but phonologically word-level: e.g. compounds whose members do not occur independently (Mascaró 2016) and complex place names (Köhnlein 2015).

Finally, combining this approach to cyclic reapplication with a dual-route race model of morphological processing (Schreuder & Baayen 1995) makes the prediction that reapplication effects will propagate historically by lexical diffusion in ways that are sensitive to lexical token frequency. This prediction is illustrated by English /aɪ/-raising (◀❷) and by pretonic stress preservation in forms like *imp[ɔ]rtation* vs *trànsɹp[ə]rtation*.

Suggested reading: Kiparsky (2007), Bermúdez-Otero (2012: 26-39), Mascaró (2016).

## ❸ *Storage 2*

Thu 18 Jul 1pm

### Listed stem allomorphs and via-rules

This session addresses lexically restricted alternations, focusing on two examples from Spanish: mid-vowel diphthongization (Bermúdez-Otero 2013: §3) and mid-vowel raising in third-conjugation verbs (Bermúdez-Otero 2016: §2). In both cases, whether or not a stem participates in the alternation is unpredictable, and extensions of the alternation to new items are sporadic at best. For those stems that do participate in the alternation, however, the distribution of the alternants is phonologically conditioned, automatic, and exceptionless.

Halle at al.'s (1991) purely phonological analysis of the diphthongal alternation incurs an exorbitant cost, involving absolute neutralization, rampant extrinsic ordering, and the weakening of the notion of cyclic domain (◀❹). In turn, Embick (2012) analyses the raising alternation by means of a lexically-restricted postcyclic morphophonemic rule, which involves blatant violations of modularity and inward cyclic locality. Neither analysis demarcates the productive part of the pattern (the distribution of alternants) from the unproductive part (membership in the alternating set).

I advocate, instead, an account involving phonologically driven selection among lexically listed stem allomorphs. As shown in Bermúdez-Otero (2013: §3, 2016: §2), this approach maintains modularity, correctly predicts the size of local domains for allomorph selection, and demarcates the productive and unproductive aspects of the alternations. Stem storage is independently supported by evidence from psycholinguistics (recognition latencies, ERPs) and diachrony (failure of analogical levelling to cross lexical category boundaries).

Elaborating this approach, however, I argue that stored allomorphs are linked by **via-rules** (Vennemann 1972: 225), i.e. by ‘non-directional, non-generative relational rules’ (Tiersma 1978: 65) akin to the ‘non-productive schemata’ of Jackendoff & Audring (2018). Via-rules capture a range of facts: e.g. that the alternations fall into a small number of recurrent patterns (cf. e.g. Revithiadou et al. 2019), that the learnability of an ‘irregular’ form depends not only on its own frequency but also on that of its class (Yang 2005), that unproductive patterns may show ‘islands of reliability’ (Albright et al 2001), etc.

By the end of this session, we will have derived a taxonomy of alternations consisting of no fewer than six basic types: strong suppletion, weak suppletion (with via-rules), stem-level phonological alternation (with nonanalytic listing), word-level phonological alternation (with analytic listing or without listing), phrase-level phonological alternation, and gradient phonetic alternation.

Suggested reading: Bermúdez-Otero (2013: §3, 2016: §2), Yang (2005), Jackendoff & Audring (2018).

## ⑥ *History 1*

Mon 22 Jul 1pm

### **The life cycle of phonological processes and rule scattering**

This session explores the diachronic evolution of alternations. I show how the stratal architecture of the grammar lays down the track for the typical life cycle of phonological processes, which I illustrate with examples from English: postnasal /g/-deletion, /l/-darkening and vocalization, and /ɹ/-lenition and deletion. In this survey of the life cycle of phonological processes I pay particular attention to two questions:

First, I examine the mechanism of **domain narrowing**, whereby phonological processes historically climb from lower to higher strata, thereby coming to apply in smaller cyclic domains. This issue raises the question of how to implement an anti-alternation bias in a stratal-cyclic system.

I then turn to the evidence for **rule scattering**, whereby diachronically innovative versions of a process applying in a high module or stratum often coexist synchronically with their older avatars, which continue to apply in lower modules or strata. Rule scattering illuminates the morphosyntactic conditioning of variable processes, and it reconciles the modularity of Stratal Phonology with the evidence of phenomena such as English /l/-darkening, which show both phonetic gradience and cyclic effects simultaneously.

Suggested reading: Bermúdez-Otero (2015), Turton (2017), Bailey (under review).

## ⑦ *History 2*

Thu 25 Jul 1pm

### **Endogenous stratal splits and the life cycle of affixes**

The last session in the course addresses the relatively under-researched topic of the diachronic genesis and evolution of splits between stem-level and word-level affixation. I launch the discussion by considering evidence from closed syllable shortening in Early Middle English and from mid-vowel

diphthongization in Early Modern Spanish. In both cases, a phonological process becomes confined to cyclic domains that exclude the most highly productive and semantically transparent affixes (e.g. regular inflection), whilst items that have to be lexically stored (e.g. irregular inflectional forms, semantically noncompositional derivatives) continue to alternate as before. The facts appear consistent with a dual-route race model of morphological processing (◀③,④) interacting with an anti-alternation bias (◀⑥). The Early Middle English evidence, moreover, shows that key elements of the stratal organization of the present-day language predate intense contact with Anglo-Norman French and Renaissance Latin and Greek; contrary to widespread belief, therefore, the English split between ‘class-one’ and ‘class-two’ affixation originated endogenously. Additionally, further evidence from Modern English and Modern Hebrew indicates that affixes that hitherto participated in stem-level alternations can develop word-level behaviour as a result of an uptick in productivity or expansion of use (cf. also the ‘botheration effect’ ◀③).

This picture suggests that, although particular synchronic stratification régimes may look arbitrary and lopsided, they evolve historically in orderly ways that reflect law-governed interactions between computation, storage, and use. The course concludes by raising the possibility of providing an emergentist account not only of the stem-level syndrome (◀③,④), but of the whole architecture of phonology.

Suggested reading: Bermúdez-Otero (2013: §3.5), Meir (2006), Bermúdez-Otero (2012: 75–77).

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