

## 1.2 Lexical Phonology crippled by the legacy of *SPE*

### 1.2.1 The abstractness and duplication problems in Lexical Phonology

The problem of opacity should encourage OT to seek an alliance with the theory of cyclicity and stratification. The latter can look forward to the benefits of such a match too, for its previous partner, the rewrite rule formalism of *SPE*, was responsible for the crisis of Lexical Phonology in the early 1990s. As we shall see in this section, Lexical Phonology tried to use the theory of cycles and levels to constrain *SPE*'s apparatus of minimally specified underlying representations and extrinsically ordered rewrite rules. However, this attempt was doomed to failure from the start, and it fatally undermined the basic concepts of cyclic domain and of phonological level. Fortunately, the theory of cyclicity and stratification need no longer run on rewrite rules, and so its progress can now resume.

A moderately close reading of collective works such as Hargus and Kaisse (1993) and Wiese (1994) will confirm that, by 1993, Lexical Phonology was in disarray. All its practitioners subscribed to the fundamental concepts of cycle and level as defined in §1.1 (see further §2.3): phonology was assumed to be cyclic, in the sense that the phonological function applied recursively over progressively larger domains associated with morphosyntactic structure; and it was agreed that different morphosyntactic categories (such as words and sentences) could belong to different phonological levels (lexical or postlexical), in the sense that different sets of phonological rules would apply in the corresponding domains. Beyond this theoretical core, however, confusion reigned.

First, the principles of Strict Cyclicity (Kean 1974, Mascaró 1976, Halle 1979, Pesetsky 1979: §3.1; after Chomsky 1973: 243) and Structure Preservation (Kiparsky 1982a: 45, 1983: 4, 1985: 92) had become mired in empirical and conceptual difficulties. Strict Cyclicity was finally laid to rest—after nearly two decades of costly theoretical investment—by Kiparsky (1993), who showed that cyclic application and blocking in nonderived environments are not consistently correlated. Structure Preservation had never been satisfactorily formalized in the first place, and there was considerable uncertainty over its intended empirical scope (Macfarland and Pierrehumbert 1991, Kaisse and Hargus 1994); counterexamples were adduced by Mohanan and Mohanan (1984), John Harris (1987, 1989, 1990), and Hall (1989), among others.

Secondly, the use of underspecification in Lexical Phonology was particularly contentious. Kiparsky (1982a: §3.2, 1982b: 167ff.) had invoked radical underspecification in his solution to *SPE*'s duplication problem (see below). In the early 1990s, he continued to rely on this device for the analysis of phenomena as varied as blocking in nonderived environments and lexically diffusing change (Kiparsky 1993, 1995). However, the evidence of anomalies, both conceptual and empirical, was mounting (Mohanan 1991, Steriade 1995).

It is important to be precise about the origin and extent of this crisis. The components of Lexical Phonology that regulated the interaction between syntax, morphology, and phonology—i.e. cycles and levels—were working well. Admittedly, there was an ongoing debate

between interactionist and noninteractionist conceptions of the phonological cycle (Kaisse and Hargus 1993: §2.2); this debate had a bearing on issues such as the nature of nonconcatenative morphology and the availability of derived phonological information to morphology, but it did not undermine the evidence for the cycle itself (see §2.5 below for further discussion).

Similarly, the Siegel-Allen theory of level ordering (Siegel 1974, Allen 1978), which had stimulated much early work in Lexical Phonology, had been refuted by Aronoff (1976: 85), Aronoff and Sridhar (1983), and Fabb (1988); but the collapse of the Siegel-Allen theory did not threaten the thesis that different affixation operations could create domains for different sets of phonological rules: see e.g. Sproat (1985: §4.3.2), Halle & Vergnaud (1987a: 77ff.; 1987b: 53ff.), and §2.6.2 below. In sum, cyclic application and stratification were in good health; the components of Lexical Phonology that were failing badly were those that governed the content of underlying representations and rule application in the earliest phonological stratum: namely, underspecification, Strict Cyclicity, and Structure Preservation. The cause of these symptoms is now easy to diagnose: for contingent historical reasons, the theory of cycles and levels had become saddled with the hopeless task of constraining the rule machinery of *SPE*.

It is worth revisiting the concatenation of circumstances that led to this unhappy outcome (see e.g. Kaisse and Shaw 1985: §4.1). In the late 1960s and early 1970s, *SPE*'s liberal use of free rides (Zwicky 1970) and absolute neutralization (Kiparsky 1968[1982]: 127ff.) caused scandal, sparking what became known as 'the abstractness controversy' (e.g. Kiparsky 1968, Hyman 1970, Crothers 1971). Notoriously, *SPE* posited derivations such as /bē/→[biy], /bā/→[bēy], and /bī/→[bāy] for nonalternating items like *bee*, *bay*, and *bye*; these mappings were effected by means of free rides on a word-level rule of long vowel shift (see e.g. Chomsky and Halle 1968: 198; I retain *SPE*'s transcriptions). Similarly, *nightingale* was assumed to escape trisyllabic shortening because its underlying representation contained a velar fricative: two rules mapping /nixtVngǣl/ onto /nītVngǣl/ counterfed trisyllabic shortening (Chomsky and Halle 1968: 233-35). Kiparsky made an early attempt at curbing the abstractness of the *SPE* framework by means of the Alternation Condition (Kiparsky 1968, 1973):

(1,1) *Alternation Condition* (Kiparsky 1973: 65)

Neutralization processes cannot apply to all occurrences of a morpheme.

This statement reflects the basic intuition that, in the absence of evidence from alternations, learners will adhere to the identity map; this insight continues to inform research into learnability within OT (e.g. Bermúdez-Otero 2003: §4.4; McCarthy 2005: 20).<sup>1</sup> However,

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<sup>1</sup> Of course, this is not to say that optimality-theoretic learning models embody exactly the same assumptions as the Alternation Condition. The latter prevents neutralization rules from applying in nonalternating items. However, phenomena such as /t/ and /d/ flapping in Canadian English suggest that this is too strong: Bermúdez-Otero (2003) shows how a child acquiring Canadian English can map surface [mɔ̃rɔ̃] 'mitre' onto word-level

hypotheses like the Alternation Condition could find no room in the extremely idealized and indirect approach to language acquisition adopted by transformational theory, where claims about the learner's capacities were largely recast as claims about an evaluation measure that compared alternative grammars according to their formal properties.<sup>2</sup>

Thus, the terms on which the debate was conducted at the time led Kiparsky to search specifically for a formal principle of rule application capable of curbing the abstractness of underlying representations. He took a first step in this direction by reformulating (1,1) as a statement confining the application of neutralization rules to derived environments, i.e. to sequences created by morphemic concatenation or by the prior application of another phonological rule.

(1,2) *Revised Alternation Condition* (Kiparsky 1973: 65)

Neutralization processes apply only to derived forms.

However, the notion of 'neutralization process' remained formally undefined: the only way to tell if a rule was neutralizing or not was to check the derivations of the grammar to see if the rule merged underlyingly distinct sequences (Kiparsky 1982a: 40, 1993: 278). A solution to this problem suggested itself when Mascaró (1976) advanced the hypothesis of Strict Cyclicity. According to this principle, all members of the set of cyclic rules (which was later typically assumed to be coextensive with the set of stem-level or 'level-one' rules) were subject to blocking in nonderived environments. In (1,3a) I give a summary statement of the Strict Cyclicity hypothesis (Kiparsky 1982a: 41); (1,3b) reflects the qualified version that became current from the mid 1980s (see e.g. Kiparsky 1985: 89-91, Halle and Mohanan 1985: 97, Kaisse and Shaw 1985: 22).

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/məɪtəɹ/, and surface [spɑɪəɹ] 'spider' onto word-level /spɑɪdəɹ/, through exposure to phrase-level alternations such as [ɹəɪt - ɹəɪtʌp] 'write - write up' vs [ɹaɪd - ɹaɪtʌp] 'ride - ride up' (see chapter 5 for discussion, and McCarthy 2005 for a similar idea). Alderete and Tesar (2002) claim that the learner should be able to depart from the identity map on the basis of purely distributional evidence without help from alternations, but it remains unclear how this is to be achieved: so far, the scope of simulations using contrast analysis (Tesar 2004, Alderete et al. 2005) is severely restricted.

<sup>2</sup> It was impossible to produce an actual learning algorithm for *SPE* (cf. §1.1); automated rule learners do of course exist (e.g. Albright and Hayes 2003), but they do not return the kind of extrinsically ordered, maximally economical rule batteries postulated in *SPE*. Chomsky circumvented this obstacle by focusing on an ideal scenario in which Universal Grammar delivered to the learner a range of grammars compatible with the primary linguistic data; an evaluation measure could then be supposed to select the optimal grammar from this range. Through this manoeuvre, intractable questions about how and why learners acquired certain generalizations and not others were recast as issues of formal comparison between grammars: see Chomsky (1957: ch. 6; 1965: ch. 1, §6-§7), Kiparsky (1974[1982]: 189), and the discussion of Structure Preservation below. However, this approach severely limited the study of learnability and of diachronic reanalysis: Kiparsky (1971[1982]: 57-58) asserted—correctly—that a purely formal evaluation measure would prove insufficient, but Kiparsky (1978[1982]: 235) made it clear that the inclusion of substantive constraints in the evaluation measure was regarded as theoretically undesirable.

(1,3) *Strict Cyclicity*

- a. Cyclic rules apply only to derived representations.
- b. 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.

This hypothesis was false, as Kiparsky (1993) was later to show,<sup>3</sup> but at the time its allure proved irresistible because it offered a principled explanation for the failure of trisyllabic shortening in *nightingale*: as a cyclic rule, trisyllabic shortening could not apply to /nītVngǣl/ because this item met the structural description of the rule already in its underlying representation; there no longer was any need to posit a rule diacritic or an underlying /x/ subject to absolute neutralization.<sup>4</sup>

I have revisited this well-worn tale in order to show that the ascendancy of Strict Cyclicity during the late 1970s and 1980s owed little to its empirical merits, but much to an overriding desire to constrain *SPE*'s rule apparatus by the narrow means afforded by a purely formal evaluation measure. Sadly, Lexical Phonology paid the most grievous price for this meagre victory over the velar fricative of /nixtVngǣl/ (see note 4): as we shall see in §1.2.2, the unassailable position long accorded to Strict Cyclicity had the effect of evacuating all empirical content from the concepts of cyclic domain and of phonological level.

The history of Structure Preservation is entirely parallel. As I noted above, the empirical scope of this principle was never made quite precise, but its general import was understood to be the following:

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<sup>3</sup> More specifically, Kiparsky (1993: §2.1) demonstrated the existence of cyclic rules that applied in structure-changing fashion to nonderived representations. By then, blocking in nonderived environments had also been repeatedly observed among noncyclic rules: see e.g. Hualde (1989).

<sup>4</sup> Strict Cyclicity was vastly more permissive than the Alternation Condition, as it allowed absolute neutralization to take place postcyclically (Kiparsky 1985: 87-88). In this sense, it was still possible to derive *nightingale* from underlying /nixtVngǣl/. However, Kiparsky (1982a: 57-58) argued that the more concrete underlying representation /nītVngǣl/ would be preferred because it involved a shorter derivation; this appeal to a formal criterion of simplicity accorded well with contemporary ideas about the evaluation measure (see note 2). Similarly, free rides on the rule of vowel shift, such as /bē/→[bīy] 'bee', would still be permitted—and indeed required—as long as vowel shift was formulated as a single postcyclic rule applying only to long vowels: cf. McMahon (1990), who postulated two cyclic rules of short vowel shift and long vowel shift. However plausible McMahon's reanalysis may have been, Kiparsky's (1982a: 57-58) version of the evaluation measure did not automatically decide in its favour, because, in this case, the criteria of derivation length and of rule simplicity conflicted. McMahon (2000: e.g. 53) comments acidly on the ease with which practitioners of Lexical Phonology circumvented the theory's constraints on abstractness.

A [level-one] phonological rule may not apply to create some segment which is nondistinctive—that is, not a phoneme of the language. Nor may structures which violate structural templates, such as syllable structure or stress patterns, be created [at level one].

(Borowsky 1989: 148)

The restriction had originally been intended to apply at all lexical levels (Kiparsky 1982a: 66–67), but it was soon confined to the stem level ('level one'), as adumbrated by Kiparsky (1985: endnote 3) and explicitly assumed by Borowsky (1986; 1989: 147, 149). Yet Structure Preservation did not arise in response to empirical observations suggesting that rules creating allophones always applied in domains larger than stem-level categories; in fact, John Harris (1989, 1990) was soon to prove the opposite with a barrage of data from English. Rather, Structure Preservation arose primarily as a by-product of the attempt to fix another problem with *SPE*'s rule machinery: not the abstractness problem this time, but the duplication problem (Stanley 1967: §1.5–§1.6; Chomsky and Halle 1968: 382; Clayton 1976; Kenstowicz and Kisseberth 1977: 136ff.)

Early generative phonology asserted that, if a feature was not contrastive in a particular environment, then it could not be underlyingly specified in that environment; rather, it would be inserted by a redundancy rule (Halle 1959). This claim was grounded on assumptions about language acquisition and, in particular, about the evaluation measure (see above, specially note 2). The evaluation measure was supposed to encode the criteria whereby the learner chose one grammar from among the many compatible with the primary data; the grammar so chosen was designated as 'optimal'. Obviously, the right evaluation measure would assign a low value to grammars which failed to capture systematic patterns: notably, it would reject grammars in which morphemes possessed their predictable properties by arbitrary stipulation in the lexicon. Assuming underspecification enabled Halle to devise an evaluation measure that attained this goal by means of a purely formal criterion: namely, by minimizing the total number of symbols contained in both the underlying representations and the redundancy rules. Underspecifying lexical representations for predictable features and inserting those features by means of redundancy rules would reduce the total symbol count in the grammar whenever the number of features eliminated from the lexicon exceeded the number of features employed in the statement of the redundancy rule (see e.g. Chomsky and Halle 1968: 381, 389). The ninth chapter of *SPE* advanced even further in this direction: language-particular grammars were argued to include a set of universal marking conventions (both context-sensitive and context-free); compliance with these generalizations was expressed by leaving unmarked feature values unspecified in lexical representations.

Quite early on, however, a troubling duplication had been noticed: the rules applying in structure-changing fashion to morphologically complex items often enforced exactly the same generalizations that redundancy rules captured in blank-filling mode. Clear examples included languages like Chamorro, which lacks phonemic /y, ø/ and which exhibits alternations where

the assimilatory fronting of /u, o/ is accompanied by unrounding to [i, e] (see e.g. Kenstowicz and Kisseberth 1977: 137-38). Such phenomena suggested that a single set of generalizations (such as the ban on front rounded vowels in our Chamorro example) governed both the content of underlying representations and derivations at the highest phonological level.<sup>5</sup> Recall, however, that the standard theory of the evaluation measure committed one to an underspecified lexicon and, therefore, to the existence of marking conditions preventing certain feature values from being underlyingly specified in certain contexts. In consequence, there now was an irresistible pressure to assume that such marking conditions would remain in force at the stem level ('level one'), for the phenomenon of duplication had indicated that generalizations over underlying representations and over stem-level derivations were the same. Kiparsky took precisely this step:

(1,4) *Structure Preservation* (after Kiparsky 1985: 92)

Marking conditions applicable to underived lexical representations apply also to lexical representations derived at level one.

Just as Strict Cyclicity gained immediate acceptance because it promised a solution of sorts to *SPE's* abstractness problem, so awareness of *SPE's* duplication problem led the practitioners of Lexical Phonology to embrace Structure Preservation. This had little to do with the empirical content of either principle. Structure Preservation was soon put to use to explain phenomena such as the phonological inertness of predictable features (e.g. voicing in sonorants: see Kiparsky 1985); but Mohanan (1991) and Steriade (1995) exposed the problems incurred by this line of research. As we noted above, Structure Preservation also predicted that rules creating allophones should always apply in domains larger than stem-level categories; but English spectacularly refuted this prediction (John Harris 1989, 1990). Yet, despite mounting counterevidence, Lexical Phonology adhered doggedly both to Strict Cyclicity and to Structure Preservation because these principles were seen as essential to a restrictive theory of rule application; the way they were upheld was by entirely subverting the concepts of cyclic domain and phonological level. The following sections give examples of this disastrous practice.

### 1.2.2 The deleterious effects of Strict Cyclicity

Present-day English has a well-known constraint that prevents the noncoronal voiced plosives /b, g/ from occurring in coda position after a homorganic nasal; where necessary, this

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<sup>5</sup> Stanley (1967: note 13) had stated, rather vaguely, that redundancy generalizations were obeyed only by phonological rules ordered relatively early in the derivation. As we noted above, Kiparsky (1982a: 66-67) assumed that redundancy generalizations held throughout the lexicon, whereas later versions of Lexical Phonology suggested that they were turned off after the stem level: see Kiparsky (1985: endnote 3), Borowsky (1986; 1989: 147, 149).

phonotactic restriction is enforced by deleting the plosive (see e.g. Borowsky 1993: 202). As shown in (1,5a) and (1,5b), postnasal plosive deletion applies normally within stem-level domains: the relevant plosives disappear in the coda, but surface when syllabified in the onset before a vowel or syllabic sonorant belonging to a stem-level morph. Before word-level suffixes, however, deletion overapplies: the plosive is suppressed even if it could have surfaced in onset position (1,5c).

(1,5) *Postnasal plosive deletion*

a.		b.		c.	
bomb	[bɒm]	bombard <sub>V</sub>	[,bɒm.'bɑ:d]	bombing	['bɒ.mɪŋ], *['bɒm.bɪŋ]
thumb	[θʌm]	thimble	['θɪm.bl̩]	thumbing	['θʌ.mɪŋ], *['θʌm.bɪŋ]
crumb	[krʌm]	crumble	['krʌm.bl̩]	crumby	['krʌ.mɪ], *['krʌm.bɪ]
long	[lɒŋ]	elongate <sub>V</sub>	['i:lɒŋ.ɡeɪt]	longish	['lɒ.ŋɪʃ], *['lɒŋ.gɪʃ]

These data clearly show that postnasal plosive deletion is stem-level rather than word-level: the domain within which the process applies normally includes all stem-level morphological material, but excludes word-level affixes such as the participial suffix *-ing*, adjectival *-y*, and adjectival *-ish* (for discussion of comparative adjectives like *long-er* ['lɒŋ.ɡə], see §2.4.3.3 below).

The ascription of postnasal plosive deletion to the stem level has implications for the morphological constituency of the items in (1,5b). Synchronically, some of these forms could conceivably be parsed either as single morphs or as stem-level morph combinations. In this light, consider the item for which a complex parse is most obviously appropriate: *e-long-ate<sub>V</sub>*. Since postnasal plosive deletion applies at the stem-level, the base of *e-long-ate* cannot trigger a stem-level cycle by itself, for it evades deletion: in other words, the domain structure \* $[[_{SL} i: [[_{SL} lɒŋg] eɪt]]$  cannot be right. Accordingly, if one assumes the stem level to be internally cyclic (as was standard in Lexical Phonology; cf. §2.6.3), then *e-long-ate* must be parsed as a root-based construction, for roots—as opposed to stems and words—do not constitute cyclic domains (Kiparsky 1982a: 32–33, 1982b: 144–45; Inkelas 1989: §3.5.5; and see §2.6.1.2 below). In English, distinguishing root-based constructions from stem-based ones can be difficult, as the language allows stems to be derived from roots without overt affixation (cf. languages like Spanish, where nearly every stem contains an overt stem formative: Bermúdez-Otero 2007d, 2007c). Nonetheless, there is independent morphological evidence to support the claim that the complex items in (1,5b) are based on roots rather than stems. For example, the construction that gives rise to *e-long-ate*<sup>6</sup> typically applies to bases that are manifestly uninflectable and so cannot be stems: e.g. *e-duc-ate*, *e-dulcor-ate*, *e-jacul-ate*, *e-maci-ate*, *e-man-ate*, *e-mancip-ate*, *e-migr-ate*, *e-mascul-ate*, *e-nunci-ate*, *e-radix-ate*, *e-vacu-ate*, *e-viscer-ate*, etc. A fortiori, any

<sup>6</sup> For our present purposes it does not matter whether *e-long-ate* is derived by circumfixation or rather by suffixation plus prefixation.

analysis in which *thimble* consists of the two morphs /θimb-/ and /-l/ must treat the latter as a ‘cranberry morph’ and the former as an uninflectable root allomorph, for there are no such words as \**thimb*, \**thimb-s*, \**thimb-ing*, etc.

However, if forms like *e-long-ate* exhibit normal nonapplication of postnasal plosive deletion only because they are root-based rather than stem-based, then our analysis makes a novel and surprising prediction: postnasal plosive deletion should overapply not merely word-finally and before word-level affixes, but also before stem-level affixes in stem-based (as opposed to root-based) morphological constructions. Gratifyingly, this prediction appears to be correct: a likely example is the 1960s neologism *swingometer* [swɪ.ˈŋɒ.mɪ.tə], used in British English to refer to a device used in BBC television programmes to demonstrate how the electorate’s possible ‘swing’ to a political party may affect the outcome of an election (see Simpson and Weiner 1989, and Wells 1990, *sub voce*). *Swingometer* is a telling example for three reasons. First, it is a new formation, not an inherited item or a loan, and so it illustrates the productive application of morphological and phonological processes. Secondly, the addition of the neoclassical element *-ometer* must define a stem-level phonological domain, since it causes primary stress to shift to the right (I assume, following Selkirk 1982: 83, 98–100, that neoclassical elements like *therm-* and *-ometer* are bound roots rather than affixes). Finally, the semantics suggests that *-ometer* is added to the noun *swing*, itself derived from the verb *swing* by conversion; if so, *swingometer* cannot possibly be a root-based construction.<sup>7</sup>

In conclusion, a stratal-cyclic analysis of postnasal plosive deletion should run as in (1,6).<sup>8</sup> Nodes that trigger cycles are highlighted in italics.

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<sup>7</sup> In turn, since postnasal plosive deletion exhibits stratum-internal cyclic misapplication at the stem level, as in (1,6d), one predicts that the stem-level ban on onset [ŋ] must be able to sustain outright lexical exceptions. This prediction follows by Chung’s Generalization (Chung 1983: 63), which Stratal OT derives as a theorem from first principles: see Bermúdez-Otero and McMahon (2006: 400), Bermúdez-Otero (2007b), Kiparsky (2007), Collie (2007: 252ff.), and §2.6.3 below. Strikingly, the prediction proves correct, as shown by monomorphemic items like *dinghy* [ˈdɪŋ.ɪ] (also [ˈdɪŋ.gɪ]); see Wells (1990: *sub voce*). The list of exceptions grows particularly large if one includes proper nouns: e.g. the place name *Singapore* [ˌsɪŋ.ə.ˈpɔː] (also [ˌsɪŋ.gə.ˈpɔː]), and the names of the British politicians Sir *Menzies* [ˈmɪ.ŋɪs] Campbell and Sir Bernard *Ingham* [ˈɪ.ŋəm].

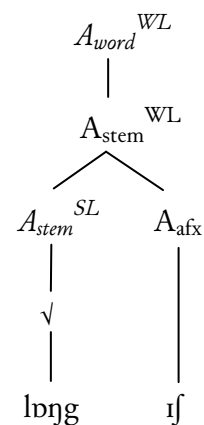
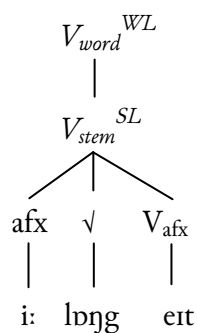
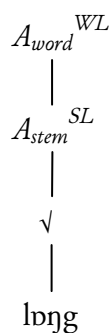
<sup>8</sup> The derivations in (1,6) do not show the interaction between nasal place assimilation and postnasal plosive deletion. In the framework of Stratal OT, this interaction must be modelled transparently, as both processes apply tautocyclically in the first cycle. Therefore, the mapping /ŋg/ → [ŋ] cannot be described as a two-step counterbleeding derivation (i.e. /ŋg/ → ŋg → [ŋ]), but must be treated as a one-step operation of coalescence: see Bermúdez-Otero (1999: 68–69, specially note 7).



(1,6)

a. *long*b. *elongate*c. *longish*

morphology



domains

[[WL [SL lηg]]]

[[WL [SL i:lηgeit]]]

[[WL [SL lηg] ηf]]

SL (plosive deletion)

lη

i:lηgeit

lη

WL

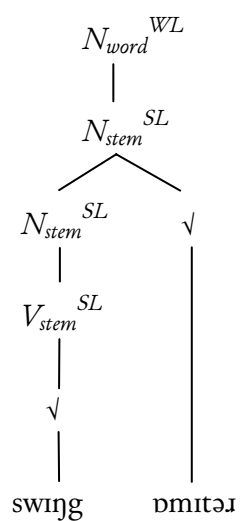
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lη.ηf

d. *swingometer*

morphology



domains

[[WL [SL [SL [SL swηg]] ∂mιt∂r]]]

SL (plosive deletion)

swη

—

swι.η∂.mι.t∂r

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(1<sup>st</sup> cycle)(2<sup>nd</sup> cycle)(3<sup>rd</sup> cycle)

WL

The well-known process of nasal cluster simplification that affects forms such as *damn* [dæm], *damn-ing* ['dæ.mɪŋ], and *damn-ation* [dæm.'neɪ.ʃn] calls for the same treatment. Nasal cluster simplification operates at the stem level, and so it overapplies before the word-level suffix *-ing* in the participle *da[m]-ing*. In turn, the absence of cluster simplification in the stem-level derivative *da[mn]-ation* indicates that its base is a root, which does not constitute a cyclic domain by itself. In fact, *damn-ation* differs from *e-long-ate* and *thimb(-)le* only in that the purely morphological evidence for the root-based status of *damn-ation* is less clear. It is easy to show, on the one hand, that *-ate* and *-at(-)ion* can attach to bound roots: e.g. *fenestr-at-ion*, *obfusc-at-ion*, etc. On the other hand, *-at(-)ion* can also attach to stems and, when it does, the base defines a separate cyclic domain: observe the cyclic preservation of stress in *imagine* → *imàgin-átion* (not \**imágin-átion*); see §2.6.3. In the case of *damn-ation*, therefore, it is the phonological evidence that most clearly decides in favour of a root-based structure. Of course, once the root-based form  $[_N [_\surd \text{damn}] \text{ation}]$  is stored in the lexicon, the hypothetical stem-based alternative \* $[_N [_V [_\surd \text{damn}]] \text{ation}]$ , which would surface as \*[dæ.'meɪ.ʃn], is ruled out by ordinary morphological blocking (Bermúdez-Otero and McMahon 2006: 398).

This analysis of postnasal plosive deletion and nasal cluster simplification came within the reach of Lexical Phonology as soon as Kiparsky (1982a: 32-33, 1982b: 144-45) established that roots did not constitute cyclic domains. Yet it was never adopted, ostensibly because it was incompatible with Strict Cyclicity: in (1,6a), (1,6c), and (1,6d) the stems *long-* and *swing-* undergo plosive deletion in the first cycle even though the target string is already contained within the underlying representation of the root. Therefore, Kiparsky (1985: 89-90), Halle and Mohanan (1985: §2.5), and Kaisse and Shaw (1985: 23) concluded that postnasal plosive deletion and nasal cluster simplification had to be assigned to a noncyclic level: the word level or 'level two', exempt from Strict Cyclicity.

Revealingly, the analysis of postnasal plosive deletion and nasal cluster simplification led Halle and Mohanan (1985: 96) to consider abandoning Strict Cyclicity, thereby sacrificing Kiparsky's alternative to *SPE*'s /nixtVngæɪ/:

[...O]ne might be tempted to conclude that the S[trict] C[yclivity] C[ondition] must be abandoned. One might propose that the reason why Trisyllabic Shortening does not apply to *nightingale*, for example, is simply that it is a lexical exception, on a par with lexical exceptions like *obesity*, which the S[trict] C[yclivity] C[ondition] does not take care of anyway.

On this point, see also Mohanan (1982: 122-23). In the event, however, Halle and Mohanan opted for a different solution. Following Mohanan and Mohanan (1984: 577-78), Mohanan (1982: 121), and ultimately *SPE* (p. 85), they formulated postnasal plosive deletion and nasal cluster simplification as word-level rules conditioned by morphological brackets rather than by syllable structure:

(1,7)

- a. *Postnasal plosive deletion according to Halle and Mohanan (1985: 96), after Mohanan (1982: 121)*

$$\begin{bmatrix} \text{-son} \\ \text{+voice} \\ \text{-cor} \end{bmatrix} \rightarrow \emptyset / \text{[+nasal]}\_\_\text{] \quad (\text{word level})$$

- b. *Nasal cluster simplification according to Halle and Mohanan (1985: 96), Kiparsky (1985: 90), and Mohanan (1986: 22)*

$$n \rightarrow \emptyset / \text{[+nasal]}\_\_\text{] \quad (\text{word level})$$

In this analysis, postnasal plosive deletion did not apply to *e-long-ate* because, by Bracket Erasure (§2.4.5.3), the internal morphological structure of stem-level categories became invisible at the word level; in contrast, *long-ish* underwent plosive deletion because *-ish* was a word-level suffix, and so the morphological division between *long-* and *-ish* was visible to word-level rules. By applying at the word level, both rules escaped the blocking effect of Strict Cyclicity on the assumption that the word level was internally noncyclic.

This analysis rescued Strict Cyclicity and covered most of the facts—although it does not extend to forms like *swingometer*, *dinghy*, and *Singapore* unless additional stipulations are made; cf. (1,6d) and note 7 above. However, Kiparsky, Halle, and Mohanan failed to acknowledge its disturbing implications. As formulated in (1,7a), plosive deletion applies to the clusters /mb/ and /ŋg/ when immediately followed by any morphological bracket at the word level; the rule does not know or care what is on the other side of the bracket. Yet this is tantamount to saying that the rule cannot see word-level affixes at all, that it is blind to the effects of word-level morphological operations—the very definition of a stem-level rule. Thus, word-level categories do not constitute the true domain of postnasal plosive deletion; the inclusion of a morphological bracket in (1,7a) creates a situation where a rule applies in stem-level domains, but it is ordered in the word level.

In sum, saving Strict Cyclicity by means of (1,7) incurred crippling theoretical costs. First, an opportunity was missed to constrain the class of rules that could refer to morphological edges: the segmental rules in (1,7) violate Inkelas's (1989[1990]: 10ff.) generalized version of the Indirect Reference Hypothesis, whereby only prosodification operations may refer to morphological or syntactic information (cf. §1.3.x, §2.4.5.1). More importantly, the notion of domain became enfeebled as the correlation between domains and levels was effectively broken: being word-level no longer meant applying in word-level domains.

### 1.2.3 The deleterious effects of Structure Preservation

Attempts to uphold Structure Preservation led to an identical decorrelation between domains and levels. The problem can be illustrated with Borowsky's (1993: 209ff.) analysis of Belfast dentalization (Gregg 1964; John Harris 1985: 58, 211ff.; 1989: §5; 1990: §6.5). In certain varieties of English spoken in and around Belfast, the coronal noncontinuants /t, d, n, l/ become dental when immediately followed by /ɪ/ or /əɪ/; elsewhere, they surface as alveolar. Dentalization applies normally in tautomorphemic domains (1,8a) and in domains created by stem-level affixation (1,8b), but it underapplies when its conditioning environment is created by word-level suffixation (1,8c-d).

#### (1,8) *Northern Irish dentalization*

a.	train	[t̪ɾɪən]	drain	[d̪ɾɪən]	butter	[ˈbʊt̪ə]	‘churned cream’
	true	[t̪ɾu:]	drew	[d̪ɾu:]	Peter	[ˈpi:t̪ə]	
					matter	[ˈmæt̪ə]	
	ladder	[ˈlɑd̪ə]	dinner	[ˈdɛn̪ə]	pillar	[ˈpi:l̪ə]	
	rudder	[ˈɹʊd̪ə]	spanner	[ˈspæn̪ə]			

[ˈlʊd̪ə] ‘heavy blow’ } Ulster Scots (Gregg 1964: 185; John Harris 1989: 40)  
 bou[l̪d̪]er

b.	better	[ˈbæt̪ə]	(suppletive comparative of <i>good</i> )	sani[t̪]-ary
				eleme[n̪t̪]-ary

#### c. *forms with agentive -er:*

better	[ˈbæt̪ə]	‘one who bets’	loa[d]er	di[n]er	‘diner’
heater	[ˈhit̪ə]			ru[n]er	
wai[t]er					
shou[t]er			ki[l]er		

#### d. *nonsuppletive forms with comparative -er:*

fatter	[ˈfat̪ə]			
la[t]er		lou[d]er	fi[n]er	coo[l]er

louder [ˈlʊd̪ə] } Ulster Scots (Gregg 1964: 185; John Harris 1989: 40)  
 bo[l̪d̪]er

John Harris (1989: §5) draws the implications of this phenomenon. First, Belfast dentalization must apply at the stem level, for its domain excludes word-level affixes such as agentive *-er* and, when attaching to free stems rather than bound roots, comparative *-er* (on the word-level status of the latter, see §2.4.3.3 below). Secondly, Structure Preservation must be false, as demonstrated by the following argument. The distinction between [t, d, n, l] and [t̪, d̪, n̪, l̪] is completely allophonic in northern Irish English.<sup>9</sup> In the version of Lexical Phonology outlined in Kiparsky (1985), which assumes lexical underspecification and an evaluation measure in the style of *SPE*, this implies the existence of a marking condition preventing /t, d, n, l/ from being specified for the feature [±distributed] in underlying representations.<sup>10</sup> By Structure Preservation this marking condition must remain in force at the stem level, and so the mappings /t/→[t̪], /d/→[d̪], /n/→[n̪], and /l/→[l̪] cannot take place earlier than the word level. However, this predicts that dentalization should not underapply in word-level domains, but should rather apply normally before word-level suffixes, contrary to fact. Therefore, Structure Preservation is false. At the same time, dentalization can apply at the stem level without violating Strict Cyclicity. If coronal noncontinuants are underlyingly unspecified for [±distributed], then dentalization will apply in structure-building mode in nonderived environments (e.g. [t̪]rain, ma[t̪]er), and in structure-changing mode in derived environments (e.g. sani[t̪]-ary, eleme[n̪t]-ary): see (1,3b).

Nonetheless, Borowsky (1993: 209-10, endnote 11) could not bring herself to accept the compelling logic of John Harris's argument. The tenor of her comments suggests that she viewed the violation of Structure Preservation as sufficient in itself to cast doubt on Harris's analysis, for she acknowledged in an endnote that Harris's proposals complied with Strict Cyclicity (Borowsky 1993: endnote 11). In the same endnote, however, she deemed it implausible that an automatic allophonic rule like Belfast dentalization could apply at the same level as nonautomatic neutralizing rules such as trisyllabic shortening. Today, this reaction is hard to understand: why should it be surprising *a priori* for an allophonic rule and a

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<sup>9</sup> Dentalization has neutralizing effects in southern varieties of Irish English, where the dental fricatives /θ/ and /ð/ have been replaced by the dentals stops /t̪/ and /d̪/. In such dialects, *true* and *through* are both realized as [t̪ru:] (Wells 1982: 431, Hughes et al. 2005: 116). However, Harris (1985: 212) is careful to point out that the Belfast vernacular and, more generally, northern varieties of Irish English retain /θ/ and /ð/. In the north, therefore, the phonetic realizations of /θ/ and /ð/ remain distinct from the dentalized allophones of /t̪/ and /d̪/:

(i)	RP	Belfast	Dublin
<i>true</i>	[t̪]	[t̪]	[t̪]
<i>through</i>	[θ]	[θ]	[t̪]

<sup>10</sup> This marking condition would not exist if dentalization applied in a lexically diffusing fashion: see Kiparsky (1988, 1995) and Bermúdez-Otero (2007a: specially §21.3.3) for the relative rôles of the lexicon and the grammar in lexically diffusing phonological change. However, Harris (1985: 58, §3.7.2) does not report any evidence to suggest that Belfast dentalization is lexically diffusing.

neutralizing rule to apply in the same morphosyntactic domain (cf. §2.6.3)? Yet, during the 1980s, Strict Cyclicity and Structure Preservation had become so central to Lexical Phonology as to set up a new goal: to deduce the level ascription of rules from their mode of application, i.e. from criteria such as whether or not the rule applied in nonderived environments and whether or not the rule was allophonic.

Given the evidence for a phonological rule, how does the child determine whether it applies lexically or postlexically, and if lexically, at what level? In part, surely, from the direct evidence of forms in which the rule is applicable. But the more interesting part of the answer is that the application of rules at different points in the grammar is subject to different regulative principles, such as the Strict Cycle Condition and Structure Preservation.

(Kiparsky 1985: 85)

This quotation is symptomatic of the disease which Lexical Phonology had contracted at birth: addressing the level ascription of phonological processes, this passage implicitly subordinates the evidence of morphosyntactic domains to the ‘more interesting’ evidence of modes of application, giving centre stage to two principles, Strict Cyclicity and Structure Preservation, which in their origin had been no more than attempts to mitigate the problems of *SPE*’s machinery.<sup>11</sup> It is this theoretical climate that explains Borowsky’s reluctance to accept John Harris’s impeccable argument.

Borowsky’s alternative to John Harris’s analysis was radical. Harris (1989: footnote 2, 1990: 102-3) had convincingly preempted an attack along the lines of (1,7). Formulating the dentalization rule in such way as to be blocked by the internal brackets in  $[_N [_V \textit{run}] \textit{er}]$ , he argued, would amount to a full retreat into *SPE*’s theory of boundary symbols: even Mohanan’s (1986: 130) liberal assumptions about access to morphological information in the phonology did not permit morphological brackets to block the application of phonological rules (see also Mohanan and Mohanan 1984: §1.2). In consequence, Borowsky was compelled to adopt a more drastic solution: she claimed that, at the word level, phonological processes preceded morphological operations. Thus, she offered the following derivations:

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<sup>11</sup> As we saw in note (7), Stratal OT does make predictions about ‘modes of application’: notably, Chung’s Generalization states that stem-level phonological processes showing stratum-internal cyclic misapplication have lexical exceptions (see §2.6.3 and references therein). However, Chung’s Generalization differs from both Strict Cyclicity and Structure Preservation in two key respects: (i) it follows as a theorem from the axioms of Stratal OT, notably Richness of the Base, rather than from an attempt to patch the theory up; and (ii) it does not compromise the principle that a phonological process applies at level *l* if and only if its domain is defined by morphosyntactic categories of type *l*.

(1,9) *Belfast dentalization according to Borowsky (1993: 210)*

UR	<i>ru/n/</i>	<i>spa/n/er</i>	<i>elemen/t/</i>	<i>ru/n/</i>
SL morphology	—	—	<i>elemen/t/-ary</i>	—
phonology (dentalization)	————(blocked by Structure Preservation)————			
WL phonology (dentalization)	<i>ru[n]</i>	<i>spa[n̥]er</i>	<i>elemen̥[t̥]ary</i>	<i>ru[n]</i>
morphology	—	—	—	<i>ru[n]-er</i>
SR	<i>ru[n]</i>	<i>spa[n̥]er</i>	<i>elemen̥[t̥]ary</i>	<i>ru[n]er</i>

In this proposal, the word level became a strange beast, entirely *sui generis*: morphosyntactic operations still fed phonology at the stem and phrase levels; only at the word level was this relationship reversed. More seriously, the correlation between the morphosyntactic domain of a phonological rule and its level ascription was destroyed: rules assigned to the word level took scope over the output of the stem level, rather than over word-level categories. This was the price to pay for upholding Structure Preservation.

Having taken this drastic step, Borowsky (1993: 225) deployed a surprising argument against the standard assumption that word-level morphology fed word-level phonology: “This view predicts as well that there should be Level 2 rules which apply across the boundaries between morphemes. I have not yet encountered any such rules.” At first glance, this puzzling claim might be taken to reflect an excessive preoccupation with English: for purely diachronic reasons, English exhibits many more alternations at the stem level than at the word level (Bermúdez-Otero and McMahon 2006: §3.5). During the 1980s, however, Booij and Rubach had documented many processes applying across the board within the domain of the morphological word in languages such as Polish and Dutch (e.g. Rubach 1984; Booij and Rubach 1984, 1987). In fact, Borowsky (1993: 221) was perfectly aware of this evidence and cursorily suggested that Booij and Rubach’s data must involve the operation of phrase-level rules blocked by the edges of prosodic words (see §2.4.1). In some of the relevant languages, however, Borowsky’s alternative analysis is not viable because phrase-level prosodic words are not coextensive with morphological words; the former are larger than the latter owing to the addition of internal clitics (Selkirk 1996: 188) at the phrase level (see e.g. the discussion of German coda devoicing in §2.4.2).

Conclusion: OT is a much better partner for the theory of cyclicity and stratification:

- The extraneous motivation for principles such as Strict Cyclicity or Structure Preservation --no Strict Cyclicity, because classic OT starts from a position of excessive concreteness, rather than excessive abstractness  
--no Structure Preservation, because classic OT does not assess the restrictiveness of a grammar by counting symbols in the lexicon: example, r-measure of Prince and Tesar (). Accordingly, underlying representations are unconstrained, and generalizations about lexical segment inventories can be stated over the output of the stem level. Hence no duplication problem. Prescience of Stanley (constraints), Clayton (output-orientation), Kenstowicz and Kisseberth (solution to duplication problem would be the same as solution to conspiracies: sadly, they were ahead of their time: cf. Kiparsky 1982: 72-3 and more recently Reiss 2000: 298).
- In Stratal OT, the principle of Domain-Driven Level Ascription follows as a theorem from the transparency of mappings within cycles.

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