

Derived Environment Effects

LUIGI BURZIO
Department of Cognitive Science
Johns Hopkins University
Baltimore, MD 21218
USA
burzio@jhu.edu
ph: (410) 516-7214
fax:(410) 516-8020

Submitted for:

The Blackwell Companion to Phonology, Wiley-Blackwell. Marc van Oostendorp, Colin Ewen, Elizabeth Hume, and Keren Rice, eds.

March 1, 2009

1. Introduction

Derived environments often exhibit peculiar phonological properties. Notable effects can be identified relative to various different senses of ‘derived’ in the expression ‘derived environment’. In all cases ‘environment’ refers to some phonological context. Such environment or context can be ‘derived’ in a phonological sense, in virtue of some phonological process having applied to obtain it, or in a morphological sense, in virtue of it being the result of the combination of morphemes or other morphological operation. The following sections will first review the different cases from a descriptive point of view, and then turn to their respective theoretical accounts.

Sections 2 and 3 review the basic facts, arguing that there are three subcases overall. Section 4 turns to contemporary analyses of the two better known subcases, while section 5 reviews pre-Optimality Theory accounts of the same. Section 6 presents an account of the third subcase.

2. Phonologically derived environments

Environments that are derived by some phonological process can differ from underived environments relative to further phonological processes. An English example of this effect is provided by the following contrasting pair, where the diacritic ‘ː’ refers to a long vowel, diphthongized in accordance with the Early Modern English Great Vowel Shift, here the diphthong [iy].

(1)	Verb	-able Adjective
a.	rémedy	remé:diable
b.	lévy (as in 'levy a tax')	léviable

In (1) we assume that in both cases the calculation of the adjective proceeds from the surface form of the verb concatenated with the suffix *-able*. Such calculation would find a stage in which the position of the stress is changed in (1a) (*rémedy* \Rightarrow *remédi...*), but not in (1b). This phonologically 'derived' status of (1a) correlates with the occurrence of vowel lengthening in the adjective in (1a), compared with its absence in (1b). It is clear that it is the restressing that licenses vowel lengthening and not the opposite, because the restressing is independently predictable, while vowel lengthening is only predictable -in turn- from the restressing. Specifically, the stress of both adjectives in (1) simply conforms with the English norm, by which the rightmost stress can be at most ante-penultimate, but a syllable like *ble* (= [b̩]), with syllabic *l* can evade syllable count (Burzio 1994), hence *re.mé.di.a<ble>*, *lé.vi.a<ble>*. The lengthening of (1a) reflects a process of English phonology, which is regular aside from its non occurrence in cases like (1b), affecting vowels in the context /__CiV, (cf. *Bost[ow]nian*, *Can[ey]dian*, etc.) except for the vowel *i*, which is immune, e.g. *Palestinian* (See Chomsky and Halle 1968, 47; Halle and Mohanan 1985). Non restressing cases like (1b) are rare for independent reasons, but existing ones, like *búry/búrial* (not **b[iy]rial*; cf. restressing *mánager/managé:rial*) confirm the generalization that identity of stress (hence, non-derived status) 'blocks' lengthening.

In addition to such phonologically derived character of the structure that confronts the

lengthening in (1a), both adjectives in (1) constitute environments that are ‘derived’ morphologically, by way of affixation. The latter status is evidently not relevant to the phenomenon at hand, else no difference between (1a, b) would be expected. Finally, note as well that characterization of the difference between (1a) and (1b) would not be possible unless it was indeed the *surface* form of the verb that enters into the calculation of the adjective. Direct calculations from bare bone ‘underlying representations’ containing no stress information would predict no difference, since there would then be no ‘restressing’ in either case, just regular assignment of stress. In sum, assuming the surface forms of the verbs are relevant in (1), then the adjective in (1a) would undergo phonological re-stressing unlike the one in (1b), and thus represent a case of phonologically ‘non-derived environment blocking’ (henceforth NDEB) relative to the process of ‘CiV’ lengthening.

The literature documents several other cases of this general type across a significant spectrum of languages. Łubowicz (1999, 2002) reports the cases in (2), to which we may add the Finnish case in (3), from Kiparsky (1973), (1993).¹

¹ The original sources cited by Łubowicz are: Rubach (1984), for Polish; Kenstowicz and Rubach (1987), Rubach (1993), (1995) for Slovak; Bolognesi (1998) for Sardinian; Prince (1975) for Tiberian Hebrew. Some of the items in (2c) have been gleaned from Prince (1975) directly.

(2)		Examples	Processes	General Process/ DE-only process
a. Polish	i.	kro[k]/ kro[č]-ek 'step/ little step'	k ⇒ č	Velar palatalization/
	ii.	dron[g]/ dron[ž]-ek 'pole/ little pole'	g ⇒ ĵ ⇒ ž	Spirantization of voiced palatal affricates
	iii.	bri[ĵ]/ bri[ʝ]-ek 'bridge/ little bridge'	ĵ ⇒ *ž (underived)	
b. Slovak	i.	lop[a]t-a/ lop[a:]t 'shovel-NOM.SG./ GEN.PL.'	a ⇒ a:	Vowel lengthening/
	ii.	kazet-a/ kaz[ie]t 'box-NOM.SG./ GEN.PL.'	e ⇒ e: ⇒ ie	Diphthongization of long e:
	iii.	dc[e:]ra 'daughter'	e: ⇒ *ie (underived)	
c. Campidanian Sardinian	i.	[f]amília/ sa [v]amília 'family/ the family'	f ⇒ v	Post- vocalic voicing of obstruents/
	ii.	pisci/ belu [β]isci 'fish/ nice fish'	p ⇒ b ⇒ β	Post-vocalic spirantization
	iii.	[b]ia/ sa [b]ia 'road/ the road'	b ⇒ *β (underived)	
d. Tiberian Hebrew	i.	ktabtém/ kartáb 'we-MASC. write'/ 'he writes'	a ⇒ a:	Pre-tonic, open syllable lengthening/
	ii.	š[i]mká:/ š[e:]m-ót 'your names/ names'	i ⇒ i: ⇒ e:	High long V lowering
	iii.	qitór 'smoke'	i: ⇒ *e: (underived)	

(3)		Examples	Processes	General Process/ DE-only process
Finnish assibilation		joke-nä/ joki river-ESS./ NOM.	e ⇒ i	e-raising, word finally/
		vete-nä/ vesi water-ESS./ NOM.	te ⇒ ti ⇒ si	t-assibilation before i
		äiti-nä/ äiti mother-ESS./ NOM.	ti ⇒ *si (underived)	

In each of the cases in (2), (3), row (i) documents the existence of a process that occurs independently of whether or not the environment is derived, analogously to the restressing in (1a) above. Then, row (ii) documents the existence of a second process that occurs when the first

process has applied, analogously to the *CiV* lengthening of (1a), while row (iii) further documents the fact that the second process does *not* apply unless the first one has (NDEB), analogously to the failed *CiV* lengthening of (1b) above. Hence, in Polish, voiced palatal affricates spirantize to fricatives only when they are derived from velar stops before front vowels; in Slovak, long *eɪ* diphthongizes to *ie* only if derived via a lengthening process (induced by specific affixes); in the Sardinian case, voiced stops spirantize only when they are derived via post-vocalic voicing; and in Tiberian Hebrew, high long vowels lower only when they are derived via a lengthening process. In the Finnish case in (3), *t* assibilates to *s* before *i*, but only when the latter is derived from *e*.²

In sum, certain phonological changes appear to occur only in conjunction with other specific phonological changes, and not by themselves (NDEB).

² A similar if a bit more intricate case is that of OCP dissimilation in Yucatec Maya discussed in Fukazawa (1998 and refs.), and reviewed in Burzio (2002b). In addition, the Chamorro case in (i), from Chung (1983), Kiparsky (1993), also seems to belong in this set.

- | | | | |
|-----|------------------------|---------------------------|------------------------|
| (i) | <i>láp<u>i</u>s /</i> | <i>lap<u>é</u>s-su</i> | ‘pencil/ my pencil’ |
| | <i>hugá<u>ndu</u>/</i> | <i>hùgand<u>ó</u>-nña</i> | ‘playing/ his playing’ |

Here, high vowels lower in stressed closed syllables, but only in conjunction with the re-stressing induced by affixes, witness underived *lístu* ‘quick’. The effect of stress in creating a derived environment is thus similar to the one observed in the English case in (1).

3. Morphologically derived environments

Phonological processes may be conditioned not only by other phonological process, but by morphological processes or structure as well. Two subcases need to be distinguished, and are reviewed in turn below. In one subcase, the context of application of the phonological process spans across morphemes, as in *criti[s]-ism*, where the velar of *criti[k]* ‘softens’ before the *i*, which is across a morpheme boundary. In the other subcase, the phonological process occurs in environments that are morphologically derived, but without reference to the specifics of the morphological structure. For instance, the nouns or adjectives *altern[ɔ]te*, *moder[ɔ]te*, *design[ɔ]te* are presumably derived from the corresponding verbs in *-ate*, but without any overt morphology. Hence the vowel shortening in these cases must depend purely on derived status without reference to any particular morphological material or boundaries.

3.1 Boundary contexts

Kiparsky (1973, 1993) notes that, in addition to the case in (3) above, Finnish assibilation also displays the pattern in (4).

- (4)
- | | | | | |
|----|----------------|-------------|----------------|--------------|
| a. | <i>halut-a</i> | ‘want-INF’ | <i>halus-i</i> | ‘want-PAST’ |
| b. | <i>tilat-a</i> | ‘order-INF’ | <i>tilas-i</i> | ‘order-PAST’ |
| c. | <i>äiti</i> | ‘mother’ | | |

Here, assibilation turns *t* to *s* before *i*, but only when the latter belongs to a different morpheme

as in each of (4a, b). In particular, the failed assibilation in *ti* of *tilas-i* (4b) shows that being in a morphologically derived form is not sufficient, and that it is rather necessary for the assibilation environment itself to be created morphologically. The non-assibilating form in (4c) establishes that assibilation does not just single out final syllables, confirming the relevance of the derived environment.

The already noted English ‘velar softening’, illustrated in (5), appears to be similarly restricted to morphologically derived environments.

- (5) a. Derived: /k/ ⇒ [s] critic/ critic-ism; electric/ electric-ity; opaque/ opac-ity
b. Underived: [k] kinetic, kidney, kitchen, Viking,

I note here the item *kinematic-ity*, which would constitute a proper counterpart to Finnish *tilas-i* in (3), velar softening affecting only the [k] adjacent to the morpheme boundary, and not the initial one. A complicating factor in this classification is that velar softening has exceptions, like *monarch-ist*, *anarch-ist* and several others, raising the possibility that items like (5b) may in fact also just be lexical exceptions rather than being indicative of NDEB. Hence in this case, as in others below, classification will be dependent on the choice of analyses. I will nonetheless, assume that items like those in (5b) are *not* lexical exceptions and therefore that the classification of velar softening as operating only across morpheme boundaries like Finnish assibilation is correct. In addition and with the same caveats, I will assume that each of the phenomena in (6) below also instantiates that same type of NDEB, while the references cited in each case may be consulted for specific analyses.

(6) **Further cases of NDEB, for DEs including morpheme boundaries**

a. KOREAN PALATALIZATION (Kiparsky 1973; Iverson and Wheeler 1988)

/kot-i/ → [koc-i] ‘(sun)rise’ *mati* ‘knot’

b. POLISH VELAR PALATALIZATION (Łubowicz 2002, Rubach 1984)

/krok-i-ć/ ⇒ kro **č-i-ć** ‘to step’ **k’iśel** ‘jelly’

c. POLISH DENTAL PALATALIZATION (Kenstowicz 1994; Rubach 1984)

/serwis-e/ → *serwiś-e* ‘auto service-LOC.’ serwis ‘auto service NOM.’

d. PRE-CORONAL LAMINALIZATION IN CHUMASH (Kiparsky 1993; Poser 1982, 1993)

/s-tepuʔ/ → [š-tepuʔ] ‘he gambles’ *stumukun* ‘mistletoe’

e. SANSKRIT (**RUKI** RULE) RETROFLECTION AFTER *r, u, k, i* (Kiparsky 1973, 1993)

/agni-su/ → [agni-**ṣu**] ‘fire-DAT-PL’ *kisalaya* ‘sprout’

f. INDONESIAN NASAL SUBSTITUTION (Pater 1999)

/mɔN-pilih/ → mɔ**m**-ilih ‘to choose’ ɔ**mpat** ‘four’

g. FINNISH CLUSTER ASSIMILATION (Kiparsky 1973)

/pur-nut/ → *purrut* 'bitten' *horn**a*** 'hell'

h. MOHAWK EPENTHESIS *KW* → *KEW* (Kiparsky 1973)

/k-wi'stos/ → *kewi'stos* 'I am cold' *rú.kweh* 'man'

In each of the cases in (6) the morphologically derived environment affected by the change is compared with an otherwise identical but non-derived environment in which the change fails to occur (see portions in boldface). In all cases, the morphologically derived environment includes a morpheme boundary.

3.2 Non-boundary contexts

Turning now to cases where morphologically derived status appears to make a difference without implicating material contributed by the morphology, English vowel shortening, e.g. as in *divín-ity*, versus underived *í.vory* will serve as the prototype, although its exact analysis, given below, will be critical to this function.

Burzio (1993), (1994), (2000a) argued that while tradition had focused on individual shortening processes, like the 'tri-syllabic' shortening of *divín-ity* or of (7a) below, the actual generalization is in fact found over non-shortening contexts, while the shortening is otherwise fully general.

Consider each of the cases in (7).

(7) Vowel length in the English Latinate-derived lexicon

- a. nátur-al (náʔture)
- b. dèfam-áʔtion (defáʔme)
- c. artículat-òry (artículàʔte)
- c. oblíg-atòry (oblíʔge)
- e. álternate (áternàʔte)
- f. áspir-ant (aspíʔre)
- g. génerat-ive (géneràʔte)
- h. Elizabéʔth-an (Elizabeth)

Given the variety of vowel length changes illustrated in (7), including not only shortening but also lengthening as in (7h), separate characterization of each case would result in a colossal conspiracy, with no particular explanation of underlying causes. By contrast, the surface distribution of long vowels is straightforwardly amenable to an account in terms of stress demands. To a good approximation that sets aside occasional exceptions like *obé:sity*, long vowels are found in the ‘Latinate’ sector of the lexicon only when they are critical to satisfy accentual faithfulness to the base word, e.g. as in *desíʔr-ous* (desíʔre). Here, given the general workings of English stress, a short vowel in the penultimate syllable would result in antepenultimate (and hence unfaithful) stress, as in hypothetical **désirous*. The lengthening case in (5h) fits this characterization as well, allowing preservation of the base stress as a secondary,

thanks to the long *eː*, while the alternative **Élizábethan* with a short *e* would lose that stress altogether given the general prohibition on adjacent stresses. Since in essence only penultimate syllables are required to be heavy to bear stress in English, vowels in all other positions will be correctly expected to be short if there is a general ban on long vowels in this morphological class. The latter ban is fully general in that, while triggered by Latinate or what is also called ‘Level 1’ morphology, it does not implicate morpheme boundaries or any other specific aspect of the context.

While vowels are on this view expected to be long *only* when stress so requires, they can in fact be short even then, as revealed by cases (7f, g). Here, would-be penultimate stress is lost due to the short vowel, in contrast to, e.g. *desír-ous*, or *adhéːr-ent*.³ This variation reveals that the ban on long vowels and preservation of stress compete evenly within the grammar, allowing different lexical items to make different choices (see Burzio 2006 on the general phenomenon of ‘lexically controlled’ variation, of which this is an instance).

While I return to further details of the analysis below, the conclusion stands that in this morphologically derived domain vowel length is essentially allophonic. Vowels are required to be short, except, and variably, under stress demands. It is therefore this general requirement, statable as **Vː* that ‘blocks’ in environments that are not so derived, e.g. *dínosaur*, *ívory*, etc.

³ Case (7h) is in fact also of this type, witness the variant *hercúle-an* where the stress of its base *Hércules* is lost for the sake of avoiding a long vowel, in contrast to the further variant *hèrculéː-an*, which is just like *elízabéːth-an* (7h).

The cases listed below would appear to be of the same a-contextual type as argued for the English cases in (7), while, again, the specific analyses may be ultimately critical to the correct classification.

(8) **Further cases of NDEB, for DEs not including morpheme boundaries.**

a. ITALIAN PARTICIPLES (Burzio 1998):

as.cen.dere ‘ascend’ *as.ce.so* ‘ascended’ (less marked syllable)

b. TURKISH DISYLLABICITY CONDITION (Inkelas and Orgun 1995, 770).

ham ‘unripe’ **fa-n* ‘(note) fa-2SG.POSS’

fa-dan ‘(note) fa-ABL

(avoidance of marked prosodic structure)

c. JAPANESE TWO MORA REQUIREMENT (Itô 1990; Kiparsky 1993)

su ‘vinegar’ *choko* ‘chocolate (truncation)’

**cho*

(two mora requirement satisfied)

d. CATALAN STRESSED VOWEL LOWERING (Kiparsky 1993, 293 and refs.; Mascaró 1976)

séntrə ‘center’ *séntric* ‘centric’
direktó ‘director’ *direktóri* ‘directory’ (preferred segment)

- e. CATALAN UNSTRESSED MID-VOWEL REDUCTION (Kiparsky 1993, 294 and refs.; Mascaró, 1976)

bostón ‘Boston’ *bustun-yá* ‘Bostonian’
kátedrə ‘academic chair’ *katədrátic* ‘holder of academic chair’
(preferred segment)

- f. FRENCH *H-ASPIRÉ* (Kiparsky 1993, 294 and refs.)

Hitler ‘Hitler’ (*h*)*itlérien* ‘hitlerian’ (loss of marked segment)

As in the English case, where the presumed more marked long vowels are avoided, each of the derived cases in (8) appears to avoid some choice that is relatively more marked either prosodically, as in (a -c), or from the point of view of segmental inventories, as in (d-f), as indicated in parentheses. This contrasts with the underived counterparts where that choice is possible.

4. Proposed analyses

I now turn to proposed analyses of the different types of NDEB, beginning with contemporary attempts, comparing them later with more traditional ones. Here, I will focus in particular on the analyses of Burzio (2000a,b), (2002b) and those of Łubowicz (1999), (2002), cast within the general framework of Optimality Theory (OT; Prince and Smolensky 1993). See, however, also Kula (2008), for an account based on Dependency Phonology.

4.1. Phonologically Derived environments

4.1.1 The Entailments-based approach

Burzio (2000b), (2002a, b), (2005) argues that a pervasive property of phonological and morphological representations is that they constitute attractors to their neighbors. This attraction effect is achieved formally by means of the hypothesis in (9).

- (9) **Representational Entailments Hypothesis (REH):** Mental representations of linguistic expressions are sets of entailments. E.g. a representation consisting of A and B corresponds to the entailments: $A \Rightarrow B$, $B \Rightarrow A$ (if A then B; if B then A).

The ‘entailments’ in (9) are types of violable constraints as in OT, but, unlike OT’s ‘strict’ ranking of constraints, underlying the REH in (9) is the assumption that entailments of the same type, like ‘ $x \Rightarrow A$ ’, for any x , directly undergo summation, producing entailments of higher

strength or rank. This is analogous to the workings of neural networks, in which activation on a node A is the sum of the activation received from all nodes x to which A is connected.

Consider then a sample representation, called ‘the attractor’, consisting of four components A, B, C, D, and consider at the same time a close neighbor A, B, C, -D, differing only by the negative value of the fourth component. Under the REH (9), the latter component will stand in violation of three of the entailments generated by the attractor, namely $A \Rightarrow D$; $B \Rightarrow D$; $C \Rightarrow D$. By comparison, in a more distant representation A, B, -C, -D, differing now from the attractor by two components, the same fourth component ‘-D’ will incur a violation of only two entailments ($A \Rightarrow D$; $B \Rightarrow D$). Hence whatever other constraint/ entailment in the system may have the form ‘ $y \Rightarrow -D$ ’, it will be opposed by the attractor differently depending on the overall distance that the representation under calculation bears from the attractor.

The work just cited argues that attraction underlies a vast array of morpho-phonological phenomena. In particular, that it can reconstruct the ‘dispersion’ account of segmental inventories (Liljencrants and Lindblom 1972 ; Flemming 1995), as maximal distance among members of the inventory corresponds to minimal attraction/ entailment violation or maximal harmony. In addition, under the reduction of contextual neutralization effects to dispersion principles advocated by Steriade (2001), Flemming (2008), attraction would also reconstruct those effects in turn. In particular, segmental neutralizations (like coda devoicing) would occur in those environments that attenuate critical perceptual cues as argued by Steriade (1994 et seq.), and thus compromise distance from the nearest attractor. The latter will then exert its influence, neutralizing the contrast. Attraction thus represents a formal alternative to Steriade’s (2001)

‘Perceptual Map’ and, as argued in Burzio 2000b, is a variant interpretation of Wilson’s (2000), (2001) ‘Targeted Constraints’, which are also a formal alternative to Steriade’s Perceptual Map. Attraction has also been argued to underlie morphological syncretisms (also a type of neutralization). See Burzio (2005), Burzio (2007), Burzio and Tantalou (2007). In addition, correct characterization of assimilatory effects would also appear to require the notion of attraction. In studying the phenomenon of ‘Long Distance Consonant Assimilation’, both Rose and Walker (2004) and Hansson (2001) argue that segmental similarity is the critical trigger, while similarity is also a recognized precondition for many cases of vowel harmony (see van der Hulst and van de Weijer 1995 and refs.) In fact, however, even local assimilatory phenomena often overtly display prerequisite similarity effects, and Wayment (in preparation) argues that *all* assimilatory phenomena are responses to attraction-under-similarity relations. Consider for example the English form *in-famous*, where nasal place assimilation fails (cf. **im-famous*, versus *im-possible*). To account for this in a principled way, one must postulate that shared place (labial) would automatically result in shared continuancy, thus yielding the marked nasal fricative *ɱ. In OT, a constraint banning the latter can then correctly block the place assimilation altogether. This interaction between place and continuancy is in fact independently attested in the phenomenon of Sudanese Arabic in (10), from Kenstowicz (1994, 54 and refs.), where assimilation in continuancy occurs only if place is already shared.

- (10) a. *kitaab*[b] ‘book’ *kitaab*[f] *Fáṭḥi* ‘Fáṭḥi’s book’
 b. *kitaab*[p] *Samīr* ‘Samīr’s book’

It is clear that both the *in-famous* case and the contrast in (10) are characterizable in terms of

attraction. In both cases, a certain degree of similarity, namely ‘same place’, which would be due to nasal assimilation in the English case, but is present in the input in (10a), appears to yield a further degree of similarity (same continuancy). In the English case, such dynamics further combines with a blocking effect (*ŋ), resulting in no assimilation at all.

It should now be clear that from this point of view, the NDEB of (1), repeated in (11), would just be another attraction effect, in fact quite parallel to the one in (10).

(11)	Verb	-able Adjective
a.	rémedy	remé:diable
b.	lévy (as in ‘levy a tax’)	léviable

While the relevant relation in (10) is between two segments in the same sequence, the one in (11) is between the adjective’s stem and the corresponding verb. Just as in (10), identity in one respect, here stress, results in identity in another, here vowel length, as in (11b). From the point of view of the REH (9), it is not an accident that attraction is at play in both cases. The latter is part of a fully parallel conception, in which all representations -and their entailments- are simultaneously co-present. Hence, in (11), the verb is present in the calculation of the adjective, just as the two assimilating segments are co-present in (10).

The REH and attraction can in general subsume the OT notion of ‘Faithfulness’, but at the same time they also subsume the OT stipulations as to which set of relations is subject to Faithfulness (Input-Output; Base-Derivative; Base-Reduplicant; Paradigms; similarity of consonants).

Similarity defines all such relations, with sequential adjacency/ proximity (as in (10)) also

contributing to similarity (Wayment, in preparation), while morphological relations (as in (11)) also contribute relevant entailments, as I discuss in sect.6 below.

In OT notation, the attraction account of (10) and (11) may be rendered as in the parallel (12a, b), respectively.

- (12) a. CC-IDENT⁺(contin.) >> IO-IDENT(contin.) >> CC-IDENT(contin.)
 b. IDENT⁺(V-length) >> * ěCiV >> IDENT(V-length)

In (12a), CC-IDENT(contin.) imposes the same value of continuancy over the CC cluster in (10), the higher ranked, ‘+’ version obtaining when there is independent identity in place. The middle constraint IO-IDENT(contin.) aims to keep the same continuancy as in the input. In (12b), on the other hand, IDENT (V-length) applies between input (verb) and output (adjective) in (11), with the ‘+’ version obtaining when there is independent identity in stress. The middle constraint here promotes a long vowel before ‘CiV’.

The attraction account of (11) as in (12b) seems correctly applicable in obvious ways to the other cases of this type as cited in (2), (3) above and notes.

4.1.2 The ‘Local Conjunction’ approach

An account of NDEB based on the formal device of Local Conjunction (LC) of constraints in OT has been proposed in Łubowicz (1999), (2002). When deployed in a case like (11), such an account would feature the hierarchy in (13), that one might compare with the one in (12b).

(13) $[* \check{V}CiV \ \& \ \text{IDENT}(\text{stress})] \gg \text{IDENT}(\text{V-length}) \gg * \check{V}CiV$

The conjunction in (13) combines one Faithfulness constraint, $\text{IDENT}(\text{stress})$ and one Markedness constraint, $* \check{V}CiV$. Simultaneous violation of both conjuncts would invoke the higher-ranked conjunction, triggering the repair as in the stress-unfaithful (11a), while the markedness constraint alone would be low-ranked, hence failing to induce the same repair, as in (11b).

It is easy to see that this approach covers also the cases in (2) as Łubowicz shows and possibly the one in (3) (but see below), given appropriate choices of Markedness and Faithfulness constraints that make up the conjunction. However, the LC approach would not extend to the bulk of the phenomena described above as being in the scope of the REH. In particular, it will not extend to (10), where case (a) features no violation of Faithfulness other than just the one caused by the assimilation in continuancy. To understand this failure, consider again (11). There are two choices for characterizing this contrast. One is in terms of clustering of identities. In (11b) verb and adjective have identical stresses and identical vowel lengths, while in (11a) neither identity holds. The other choice is in terms of clustering of changes. In (11a) there are two changes (stress and V-length), while in (11b) there are none. The REH approach goes down

the first path, and that is why it is extendable to (10). In (10a) target and trigger end up identical in both place and continuancy, while in (10b) they are different in both. The LC approach goes down the second path, namely cluster of changes. Occurrence of one change violates Faithfulness causing the conjunction in (13) to rear its head, thus causing the second change. In (10), however, there is only one change (a), versus no change (b), and hence there is no account of it in these terms.⁴

Nonetheless, the LC solution seems ingenious and has interesting typological properties, predicting that not only conjunctions of Markedness and Faithfulness constraints, but conjunctions of two Markedness as well as conjunctions of two Faithfulness constraints should prove equally useful. These predictions seem supported, to the extent that conjunctions of Markedness constraints have been consistently proposed in the OT literature (see McCarthy 2002, 18f.; Łubowicz 2002, note 4, and Fukazawa 1998 for a review), while conjunctions of Faithfulness constraints have also been proposed, to account for counterfeeding chain shifts in particular (Kirchner 1996).

The LC approach also aims to account for the fact that the changes that combine in NDEB effects often appear to affect the same local domain, as in (11a), where the same vowel both receives the new stress and lengthens. This is done by restricting the scope of constraint

⁴ The same predicament would face McCarthy's (2003) 'Comparative Markedness' approach, which distinguishes Markedness violations that are present in the input (old Markedness) from those that are not (new Markedness). As Łubowicz (2003) shows, this approach has similar effects to those of the LC approach. Conceivably, a higher-ranked 'new' * $\check{V}CiV$ could in particular apply to (11a) given the changed stress, but not to (11b). In (10), however, nothing is independently 'new' in (a) any more than in (b), yielding no account in these terms.

conjunctions to constraints that refer to the same segment, although it is not clear what the underlying principle behind such restriction would be. In fact, however, such restriction may prove too strong. While it seems appropriate for the cases in (2), it does not for the Finnish case in (3), where the two changes of ‘vete → veti → vesi’ occur in different segments. See, however, Łubowicz’ (2002, note 29) appeal to an alternative analysis that would bring this case in line. An apparently similar challenge is also posed by Sanskrit retroflexion of *s* after the disjunction *r, u, k, i*, as in the cases in (14) from Kenstowicz (1994, 202), Kiparsky (1973).

- (14) a. *sās-ta* ⇒(ablaut) *sis-ta* ⇒(*ruki* retrofl.) *śiṣ-ṭa* ‘taught, PARTICIPLE’
 b. *ga-ghas-anti* ⇒ (V deletion, other) *ja-ks-ati* ⇒(*ruki* retrofl.) *ja-kṣ-ati* ‘eat, 3 PL’
 c. *bisa* ‘lotus’

The derived forms in (14a, b) exhibit retroflexion of *s* after *i* and *k* respectively and contrast with the underived form in (c) where retroflexion does not occur. However, the changes that appear to enable the retroflexion in (a, b) do not affect the segment that undergoes the retroflexion itself, but rather other segments. These cases are therefore similar to the Finnish case, though again the exact analysis would be critical to drawing such conclusions (see Łubowicz 2002, note 29, in this regard).

In addition to these challenges to the ‘locality’ of the interaction, Burzio (2002b) also cites the English cases in (15).

(15)	Base	Derivative: more similar	Derivative: less similar	Interacting dimensions
a.	compáre	compáritable	cómparable	stress; semantics
b.	divíde	divídable	divísible	vowel length; segmentism
c.	applý dený	deníable	ápplicable	vowel length; segmentism
d.	lárýnx	lárýnxes	larýnges	stress; segmentism

The case in (15a) features an idiosyncratic semantic change in the derived adjective *cómparable*, which means ‘roughly equal’ rather than ‘able to be compared’, while the cases in (15b, c, d) exhibit idiosyncratic segmental changes in the ‘less similar’ column. In each case, such changes cluster with other changes, in stress, vowel length, or both. These latter changes are roughly predictable, though space prevents a full discussion of that here. For instance, the form *larýnges* displays regular stress (heavy penultimate), rather than the stress of its base. By comparison, the same changes ‘block’ in the absence of the first type of change, as shown in the ‘more similar’ column. Such cases of NDEB may be analyzable in terms of conjunction of Markedness and Faithfulness along the lines of (13) provided that Faithfulness constraints can appropriately detect the idiosyncratic changes described. However, as in the Sanskrit and Finnish cases, such conjunctions would not be strictly ‘local’.

As for the predictions of the REH on the exact range of interaction of changes, a full discussion is a complex matter beyond present goals. However, a useful inference can be made from the fact that the REH aims to characterize inventories as sets of attractors, combined with the independent fact that inventories are attested for segments and morphemes in particular. If these are the attractors, then attraction effects should be observable at both of these levels. Then, the cases in (2) and perhaps (1) (=11) would instantiate cases where attraction occurs between

corresponding segments, while those in (3), (14), (15) may instantiate attraction between corresponding allomorphs (note that several of the latter cases involve more significant structural changes than those in (2)). Morphological syncretism phenomena, including the type that is referred to as ‘Lexical Conservatism’ (Steriade 1999, Burzio 2007) would in any event also involve taking morphemes as the relevant attractors, from this perspective.

4.2 Morphologically Derived Environments in boundary contexts

4.2.1 The Entailments-based approach

Burzio (2000a) analyzes the Finnish case in (4b) above, repeated in (16a), as in (16b).

- (16) a. *tilat-i* ⇒ *tilas-i* ‘order-PAST’
- b. FAITH(ti) >> **TI*(Assibilation) >> FAITH(t)

In (16a), the first *t* in *tilat-i* is subject to higher-ranked FAITH(ti) and thus resists the effects of the assibilation constraint, while the second *t* is subject only to lower-ranked FAITH(t), and thus undergoes the assibilation. The reasoning behind this account is that sequences may be subject to additional forms of faithfulness compared with individual segments, a conclusion that is independently warranted for the case of geminates, which are often immune to repairs that affect their singleton counterparts (Kenstowicz 1994, 8.4). In addition, (16b) assumes that Faithfulness

is to the form of morphemes, not to morpheme combinations. This assumption is automatic under the rejection of the level of ‘Underlying Representation’ (Burzio 1996, et seq.). Without the latter level, output form *tilas-i* of (16a) can only be faithful, independently, to the stem *tilat-*, and to the past tense affix *-i*, as each, but not their concatenation, is instantiated in other surface forms.

This approach to OT faithfulness can be directly recast in terms of the REH (9) above. Among the entailments generated by occurrences of the stem *tilat-* will be the entailment ‘ $i \Rightarrow /t_$ ’ (*i* must be preceded by *t*). It is this entailment in particular that blocks the spirantization of the initial *t*. On the other hand, there is no comparable entailment for the stem-final *t*. Even considering a hypothetical form *tilat-i* such as the input form in (4b) and its entailments, the affixal *-i*, unlike the stem medial *i*, will not entail a preceding *t*. The reason is that these two *i*’s are not just random representatives of the phoneme [i], since surely there is no claim here that *i* entails a preceding *t* in Finnish at large. Rather, the stem medial *i* is that specific *i* which is in turn entailed by the rest of the representation of the stem *tilat-*, including its semantics. It is that *i* which will then entail a *t* by transitivity of entailments. Affixal *-i* cannot entail a *t* because it occurs in heterogeneous environments, attached to stems of all sorts. Any entailment of a preceding *t* would be contradicted by entailments generated by other stems that do not end in *t*, and is thus effectively suppressed under algebraic summation of entailment.^{5 6}

⁵ The only entailments that would emerge from such summation would be those that refer to properties that all the stems share, such as lexical category. This is the source of subcategorization frames for affixes in this approach (see discussion of (24) below and Burzio 2005).

⁶ The text discussion is consistent with assibilation also occurring in monomorphemic *vesi* of (3). Here, the entailment from *i* to *t* is missing because there is no *i* in the input form *vete*.

The remaining question, of course is ‘what entailments matter, exactly?’ For instance, why shouldn’t an entailment from *a* to *t* in (16a) prevent the second *t* from spirantizing while allowing the first, hence yielding **silat-i*? This question is of course just the REH version of the question already posed by (16b), which would be ‘which sequences are subject to higher-ranked faithfulness, exactly?’ Unlike the cruder (16b), though, the REH does point to an answer here. It is argued in Burzio (2005) that, while an entailment ‘ $A \Rightarrow B$ ’ is expected for any co-occurring components A, B, the strength or rank of such an entailment is demonstrably determined by the degree of similarity between A and B, such that similar elements will result in stronger mutual entailments. An intuitive grasp of such an effect can be attained by considering similarity as a sharing of subcomponents, such that entailments among A’s subcomponents will also simultaneously entail those subcomponents of B’s that are shared with A. Put differently, in a co-occurring A, B, the REH will prescribe that each of A and B will entail their own internal structure, as well as each other. When A and B are similar, the former effect will contribute to the latter, resulting in a stronger mutual entailment between A and B. A formal demonstration of this effect, including modeling with a neural network, has been presented in Wayment, et al, (2007), providing a sample application of the effect to the phenomenon of Phonetic Enhancement, whereby acoustically similar features tend to cluster together.

If this is correct, it means that similarity between two co-occurring A, B has two effects. One is attraction, with the possibility of B becoming more similar to A or vice-versa. The other is a

As for the *i* of intermediate form or candidate *veti* (after vowel raising), it might well entail, but it would do so only weakly in any event, since it is not itself entailed by the rest of the stem, as the latter entails *e* instead, as in *vete-na* of (3). The ‘attraction’ account of *vesi* given above, on the other hand, would rely on the removal of the entailment ‘ $e \Rightarrow /t_$ ’ by the vowel-raising process. There is no contradiction between the two types of consideration.

mutually confirmatory effect, with B serving as a partial endorsement of A and vice-versa. These two effects are intuitively opposite, but are not logically contradictory. Using OT concepts, the first effect, attraction, can (in the context of assimilation processes) be understood as a type of markedness, favoring an unfaithful output. The second effect, mutual confirmation, on the other hand, can be understood as pertaining to OT's faithfulness to an input. If assimilations are attraction effects as claimed above, then similarity is at play in assimilations, and the assimilatory pressure will then systematically have to contend with the enhanced faithfulness just described. This will now make the ranking in (16b) and the account of (16a) and similar cases transparent. Specifically, operating over the initial sequence *ti* in (16a), we have both enhanced faithfulness and attraction, as expressed by the leftmost two constraints in (16b), with the former evidently prevailing, yielding no change. By contrast, the final sequence *t-i* will be affected by the same attraction, but not by the enhanced faithfulness for the reasons already discussed (no entailments established across morpheme boundaries due to the heterogeneity of morphological combinations), whence the repair, as expressed by the two rightmost constraints in (16b). As for entailments from other components in *tilat-*, they are rendered comparatively inconsequential by the relative lack of component similarity, while similarity between coronal *t* and front vowel *i* is independently established in terms of shared tongue body position (Flemming 2003). In addition, non adjacent segments will be particularly inconsequential if sequential proximity is treated as a type of similarity as suggested (Wayment, in preparation).

Thus, the constraint FAITH(*ti*) of (16b) is on this view directly relatable to what is independently needed for the 'inalterability' of geminates, since the latter would be the mutually enhancing case *par excellence* --pairs that are maximally similar in features as well as sequentially adjacent.

For entailment-based accounts of other, otherwise surprising faithfulness effects, see Burzio and Tantalou (2007).

4.1.2 The ‘Local Conjunction’ approach

Łubowicz (1999), (2002) proposes a ‘local conjunction’ analysis of this case as well. When applied to the Finnish case in (17a), that analysis would be as in (17b).

(17) a. *tilat-i* ⇒ *tilas-i* ‘order-PAST’

b. [**TI*(Assibil.) >> & R-ANCHOR (Stem; σ)] >> IDENT (contin.) >> **TI*(Assibil.)

The constraint R-ANCHOR (Stem; σ) in (17b) requires that the right edge of the stem line up with a syllable boundary, and is violated in (17a). The repair in (17a) is triggered by the fact that the conjunction of the latter constraint with the assibilation constraint dominates the relevant faithfulness constraint, IDENT (continuant). No repair affects the initial *ti* sequence because in that case the scope of the assibilation constraint is not in the same local domain as the scope of the right-anchor constraint, making the local conjunction inapplicable, while the assibilation constraint by itself is ranked lower than IDENT (continuant).

A constraint like R-ANCHOR (Stem; σ) of (17b) would have no status in the perspective of the previous subsection, and it would therefore be problematic for the latter, if such a generalization

held. It appears, however, that it does not hold for several of the cases in (6) above. In particular, it does not hold for the Chumash precoronal laminalization, which alongside of the example in (6d) also features /*s-is-lusisn*/ ⇒ [*š-iš-lu-sisn*] (from Poser 1982, 1993, with presumed syllabification *šiš.lu*..., with no misalignment); the Sanskrit retroflexion of (6e) as in /*agni-su*/ → [*agni-ṣu*] ‘fire-DAT-PL’; the Finnish cluster assimilation of (6g), as in /*pur-nut*/ → *purrut* ‘bitten’; and the Mohawk epenthesis of (6h) /*k-wi'stos*/ → *kewi'stos* ‘I am cold’/. It is possible that these cases could be analyzed as processes that affect only affixal material, due to lower-ranked AFFIX-FAITH and that block in underived environments simply because those environments are stems, hence not for the reasons provided by (17b). This alternative does not seem viable for the case in (6f), repeated in (18), however.

(18) INDONESIAN NASAL SUBSTITUTION (Pater 1999)

/*mɔN-pilih*/ → *mɔm-ilih* ‘to choose’ *ɔmpat* ‘four’

Here the stem is affected by the process as much as the affix, and yet a faithful candidate *[*man-pilih*] would feature no misalignment (a ‘left’ rather than ‘right-anchor’ constraint would have to be involved in this case), hence there would be no way to activate a conjunction along the lines of (17b).⁷

Pater (1999) in fact analyzes the asymmetry in (18) not in terms of LC, but rather in term of a

⁷ Łubowicz (2002, 265) acknowledges this prediction with regard to simple nasal assimilation, which would not be expected to ‘block’ since morpheme and syllable boundaries line up, finding no counterexamples, but does not discuss nasal substitution. English nasal assimilation does in fact seem to exhibit NDEB judging from *Finland, Henry, only* compared with *illegal, irrational*, but these cases too could be attributed to lower-ranked AFFIX-FAITH.

ROOT LINEARITY constraint that aims to preserve sequential relations within a root. The mapping /*ɔmpat*/ ⇒ **ɔmat* ‘four’ would violate such constraint with respect to the input sequence *mp*, while a comparable hetero-morphemic sequence is not in the scope of the constraint. This type of analysis is in fact essentially subsumed by the above entailment-based discussion, which additionally dispenses with the stipulation that ‘roots’ are special. In morphologically underived *ɔmpat*, the *m* entails a following *p* (note their relative similarity), while the same entailment will not hold hetero-morphemically for familiar reasons, prefix *mɔN-* occurring with roots of all forms.

While these issues would thus appear problematic for the LC approach, Łubowicz (2002, 274) understandably challenges extending the theory of faithfulness to cover sequences, as in (16b) from Burzio (2000a). That challenge is defused by the above discussion, however, both by grounding such uses of faithfulness into entailments, and by the noted fact that geminates require such an extension in any event (as indirectly acknowledged by her own note 7), as does the case in (18).

5. Pre-Optimality Theory Accounts

5.1 Strict Cyclicity

This subsection reviews the most influential of the early accounts of NDEB, the one based on ‘Strict Cyclicity’, as developed by Mascaró (1976) as part of the conception of the phonological

‘Cycle’. Other accounts, thoughtfully reviewed in Kiparsky (1993) included the ‘(Revised) Alternation Condition’ and specific applications of the ‘Elsewhere Condition’.

The traditional motivation for the phonological cycle comes from the observation that Underlying Representations (URs) are insufficient for correct phonological derivations, and that reference to surface forms is also necessary, as in the famed English example in (19), from Chomsky and Halle (1968, 117).

- (19) a. cond[ɛ]nsation (cf. *cond[ɛ̃]nse*)
 b. comp[ɔ]nsation (cf. *comp[ɔ̃]nsate; *comp[ɛ̃]nse*)

The two nouns in (19) would have fully parallel URs, and yet exhibit different degrees of reduction in the bracketed vowels, a difference that seems predictable only by reference to the corresponding verbs in parentheses. The ‘cycle’ thus required the phonology to apply first to inner morphological layers, first calculating *cond[ɛ̃]nse* within *cond[ɛ]nsation*, and then move on (see Kenstowicz 1994, 204 for exact derivations, and Cole 1995 for a full review of the motivations for the cycle).

In contrast to the serial, rule-based approach, in the parallel, post OT approach, it would be less surprising to find that the construct which is conceptually unnecessary, namely UR, is also empirically insufficient as in (19). The correct move would then arguably no longer be supplementing the UR (arguably an artifact of serialism) with the ‘cycle’ (arguably another artifact), but rather simply to dispense with the UR (Burzio 1996, 2000a). Note that the

morphology is in fact also insufficient, since for instance *antágon-ist* and *Américan-ist* have parallel morphological structures and yet only the latter has the stress of *Américan*, while the former does not have the stress of **ántagon* (cf. *péntagon*). If surface forms is all there is, then **ántagon* is not one and there is no problem. But if there is a ‘cycle’, cyclic rules must know exactly how to discriminate between morphological structures that end up being real words in some other derivation and those that do not –a remarkable ability. This problem is in fact already apparent in (19), where *-at-* is just the same morpheme in both cases, but **compense*, like **antagon* is just not a word.

‘Strict cyclicity’ effects, to which NDEB effects were in turn related, can perhaps be illustrated with the simple English series in (20), but see Kenstowicz (1994, 5.3), Mascaró (1973) for the Catalan data that were actually utilized.

(20) a. *desí:re* b. *desí:r-able* c. *desí:r-abíl-ity*

Assume for present purposes that *-able* is one of the affixes that triggers vowel shortening, as shown, for instance by *admi:re/ admir-able*. As discussed above, shortening is only variable rather than systematic in stressed penultimate syllables, though, whence (20b) *de(sí:ra)<ble>*, assuming an extra-metrical syllable *<ble>* as in (1) above. The point of note is that further derivatives of *desí:rable* such as (20c) maintain this choice despite the fact that *-ity* is itself a shortening affix, witness *divin-ity* (cf. *divi:ne*), or *promiscu-ity* (cf. variant *pro:miscuous*), and the fact that metrical environments identical to that of (20c) (medial foot ($\sigma \sigma$)) shorten rather regularly, as in *pro(nùnci)átion* (cf. *pronounce*). The conclusion drawn from facts of this sort

was thus that certain processes ‘block’ in environments that are not ‘properly’ derived. The one in (20c) would be one of them, since the shortening environment is already present in (20b) (let’s say), attachment of *-ity* thus contributing nothing further. But if shortening blocks for those reasons in (20c), it may well block for the same reasons in (20a), which is not derived at all. In addition, since it is the definitional property of cyclic rules to apply *when* there is a new morphological environment, it will only be a matter of strengthening this definition to *only when* (thus making the cycle ‘strict’), to derive the blocking in both of (20c) and (20a). But now what of the stress rules, which need to be cyclic to account for (19) and other cases and yet do not block in underived environments (*América*)? This will require the further assumption that blocking is a property limited to ‘structure changing’ rules, while stress assignment is ‘structure building’.⁸

I note in passing that, while the ‘cycle’, once presumed to be at work in (19), evaporates in a parallel perspective that only has surface forms to work with, its ‘strict’ character needed to yield (20c) would not immediately do so. Here, I will assume a ‘Multiple Correspondence’ effect, along the lines of Burzio (1998), the two items in (20a, b) compounding their faithfulness effects together (by summation of entailments) to block the shortening in (20c).

Returning to Strict Cyclicity, on a par with the NDEB of (20a), the latter would provide presumptive accounts of the cases of 3.2 above (non boundary contexts), assuming all relevant process can refer to the added morphological structure, so as to activate the cycle in its presence

⁸ Kiparsky (1982) attempts to derive this effect by reducing the Strict Cycle Condition to the Elsewhere Condition (see Kenstowicz 1994, 219).

and block elsewhere, and would similarly account for ‘boundary context’ cases of 3.1 above like Finnish *tilas-i* of (4b). As for the cases that appear to be phonologically but not morphologically derived, like Finnish /*vete/* ⇒ [*vesi*] of (3), a clause like (21b) below was from the inception added to the already established (21a).

- (21) Applicability of cyclic rules
- a. Contexts that are newly created morphologically
 - b. Contexts that are newly created phonologically

This definitional fiat extended the account to phonologically derived cases such as (2), (3) and (14) above (I leave the cases in (15) aside), but it did so at a cost. The two forms of NDEB are now predicted to be coextensive, an incorrect conclusion as Łubowicz (2002, 271) points out. While there are cases, like Finnish assibilation and Sanskrit *ruki* retroflexion, that can be argued to occur in both types of derived environments, others do not. The problem is perhaps best illustrated by the English cases in (1). The case in (1a) *remé:di-able* was presumed to be phonologically derived via re-stressing. Under (21), this would be because of clause (b). But the simultaneous presence of clause (a) would now incorrectly predict lengthening in (1b) **lé:vi-able* just as well since both cases involve affixation of *-able* and hence both are ‘derived’ one way or another.

Still working within a rule-based system, Kiparsky (1993) rejects the Strict Cyclicity account of NDEB, not only because of the incorrect predictions of the disjunction in (2), but also because various other hallmarks of cyclicity failed to correlate with NDEB effects. For instance, one

diagnostic of cyclicity would be sequential orders like P_1, P_2, P_1 , where a process P_1 is found to apply before and after P_2 . The cycle would enable such orders so long as the two occurrences of P_1 could be placed in different cycles. Other properties attributed to cyclic rules, though essentially by stipulation, were application at ‘lexical’ as opposed to phrasal levels, and their contrastive as opposed to allophonic, character. Kiparsky shows clearly that NDEB does not correlate with these attributes, and thus proposes the alternative reviewed next.⁹

5.2 Underspecification

Kiparsky’s (1993) proposal can be illustrated for the Finnish cases as in (22), where upper-case *t*’s are underlyingly not specified for continuancy, while the others are fully specified as [-continuant].

- (22) a. /tilaT-i/ ⇒ tilas-i ‘order-PAST’ (cf. tilat-a ‘order-INF’)
 b. /veTe/ ⇒ /veTi/ ⇒ vesi ‘water-NOM.’ (cf. vete-nä ‘water-ESS.’)

Correct derivations in (22) are ensured by assuming that the assibilation process can fill in the value [+continuant] in the context ‘/ __i’, yielding [s], but not change fully specified (lower-case) *t*’s. At the same time, one must also assume that [-continuant] can be filled in by a later default rule, so as to yield *t*’s rather than *s*’s in the parenthesized forms on the right.

⁹ Note that parallel OT does not predict any of the formerly stipulated distinctions between lexical and post-lexical processes. A discussion of this issue is beyond present goals, but see below for some discussion of phonology-morphology interaction.

On the one hand, this proposal bears some similarity to the one in (16b) above and its entailment-based version. On the other, however, it does not appear to be fully workable. To see this, let us first suppose that the forms on the right in (22) were the sole determinants of the underlying representations on the far left. Then, indeed, the latter could be correctly obtained. The *i* of *tilat-a* would force full specification of the preceding *t*, lest the expected form be **silat-a*, given the assibilation. Elsewhere, however, (upper-case) *t*'s could remain underspecified, correctly yielding assibilation when a following *i* shows up. This dynamics is parallel to the one based on the entailments, where a following *i* would also confer additional stability to a *t*. However, the assumption that the parenthesized forms are privileged sources for the URs cannot be maintained, as argued in Burzio (2000a). Consider that, while in *divi:ne* /*divin-ity*, the UR /*divi:ne*/ with a long vowel can only be inferred from the base, in *dam(π)* /*damn-ation*, the UR /*dæmn*/, with the *n*, can only be inferred from the derivative, while in [pærðnt] / [pðrɛntðl] the full set of underlying vowels can only be inferred from base and derivative combined. The fact of the matter is that, in general, there is no principled or empirically tenable restriction on what surface forms can contribute to a UR (it totally depends on where neutralization processes occur). This means that hypothetical **tilat-i* could also contribute to its UR, yielding full specification of the second *t* incorrectly, and undercutting the account of (22). This liability is not shared by the entailments. As we have seen, affixal *-i* would not entail a preceding *t* even in a hypothetical *tilat-i*, the reason being that, as a past tense affix, it will entail to its left whatever results from entailment summation over all of its stems, most of which do not end in *t* (see fn. 7). Full parallelism of surface forms, and not underspecified URs, is thus apparently needed for a solution.

In addition, the underspecification account will not extend to the cases of phonologically derived environments aside from (22b). For example, to handle *remediabile* of (1a), this account would have to underlyingly underspecify the lengthened vowel while fully specifying (as short) the one of *leviabile* (1b). But there is no independent basis for such an asymmetry. The fundamental reason for this inadequacy is that, in general, an underspecification account will predict asymmetries based on some coherent and plausible theory of what can be marked versus default values. Hence, it cannot under any circumstances predict what appears to be the generalization behind (1), (2), (3), (14), even leaving aside (15), namely whether some change or lack of change has occurred in the same segment or morpheme. The case in (22b) (=3) is captured by underspecification accidentally, from this point of view. While it instantiates the ‘change-based’ generalization (the change ‘e ⇒ i’ enables the assibilation), it also features a *t* that does not precede an *i* in *vete-nä*, giving scope to the underspecification account. These circumstances do not extend to the other cases.

6. Morphologically derived environments in non boundary contexts

I now finally turn to the case in 3.2. above whose prototype case was taken to be English vowel shortening.

Burzio (2000a) argues that such effects simply result from the parallel interaction of morphology and phonology, the traditional level of UR proving again a hindrance rather than the source of solutions. Consider in particular that regular/ productive morphological systems generally exert

an inhibitory effect on phonological processes, as shown in (23).

- (23) a. *é*ffort-less-ness (exceptional stress)
 b. beep-ed [biypt] (exceptional syllable size)

Stress patterns such as the one in (23a) are unattested among morphologically underived items, as are syllables such as the one in (23b), where a long vowel is followed by two consonants. These effects would be types of ‘DEB’, namely reversals of NDEB. Here, otherwise regular processes ‘block’ exactly in the derived environments. Burzio (2002a) argues that one can simply interpret the selectional properties of the relevant affixes, expressible for example as in (24), to be high-ranked types of constraints.

- (24) -less ⇒ / Noun ____ (-less attaches to a noun)

If there are no URs, then the context ‘Noun’ in (24) can only refer to surface forms, affix *-less* thus demanding identity between its stem and any such form. Then, if the constraint in (24) is ranked, cases like (23a) will be accounted for by taking (24) to dominate the constraints responsible for regular stress, the irregular one of (23a) simply coming from identity with that of *é*ffort, as imposed by (24). Similarly for the past tense affix in (23b) and syllabification constraints.

If morphology and phonology compete this way, so that (23a, b) result from the morphology winning, then effects in the opposite direction should result when the morphology loses, and this

would be the case of vowel shortening, as illustrated in (25).

- (25) a. natur-al (cf. *na.ture*)
b. *V: >> -al ⇒ / Noun ____ (-al attaches to a noun)

In (25b), a general markedness constraint banning long vowels outranks the morphological constraint demanding identity with the independent noun *na.ture*, resulting in a short vowel. The difference between the high-ranked selectional constraint in (24) and the low-ranked one in (25b) reflects the general difference between (roughly) Germanic and Latinate affixes, termed respectively, ‘Level 2’ and ‘Level 1’ in Kiparsky’s (1982) ‘Lexical Phonology’ framework. This ranked-based characterization of the two morphological systems is independently supported by the fact that the two classes also differ with respect to morphological idiosyncrasy (Burzio 1994, 2002a; Benua 1997), as well as productivity, which can also be correlated with rank, though more indirectly (see Burzio 2006). Latinate affixes like the one in (25) tolerate massive amounts of morphological idiosyncrasy, as in *arbore-al* (cf. absence of **arbore*), *crimin-al* (cf. *crime*, not **crimin*). By contrast, the Germanic affixes exhibit virtually no such idiosyncrasy like hypothetical **arbore-less* (cf. *tree-less*) or **crimin-less* (cf. *crime-less*).

Hence there exists an inverse correlation between phonological and morphological regularities (Burzio 2002a), as Germanic affixes exhibit tight morphological regularity along with abundant phonological irregularity as in (23), while the Latinate ones reverse both effects, exhibiting much morphological irregularity along with regular phonology. This includes regular stress aside from a specific range of cases as discussed below, as in *parént-al* (not **párent-al*, which would

parallel *éffort-less*), regular syllabification, the shortening of (25), and other processes like the velar softening of (5) above (*electri[s]-ity*), all absent with the Germanic class (cf. *froli[k]-ing*; *cri.me-less*). The overriding generalization is thus in terms of the requirement that a stem be identical to an independent word, referred to as ‘Output-Output (OO) faithfulness’ in the literature (Benua 1997), which is strong for one class of affixes, but weak for the other (Burzio 1994). Two ingredients are critical to the present account. One is that morphology must be constraint-based. The other is that there must be full parallelism of morphology and phonology, with no UR. The first ingredient, constraint-based morphology, results from the REH (9), constraints like those in (24) and in (25b) resulting as summation of like-entailments across the lexicon (as does their rank; Burzio 2002b). The second ingredient, full parallelism, is the null hypothesis for constraint-based systems. Consider further in this regard that in the Germanic/Level 2 case of (23), the UR would be simply superfluous. One only needs to assume a high-ranked OO-faithfulness (expressed here by (24)) to express the identity of each stem to the independent words. The effect of a lower-ranked faithfulness to a UR (termed ‘Input-Output’ (IO) faithfulness) would just be occulted by the higher-ranked OO-faithfulness. In the case of (25), however, a hypothetical UR is not just superfluous, but rather false. To account for the long vowel in *na.ture*, one must assume the ranking ‘IO-FAITH >> *V’, the standard OT schema for existence of a marked choice. But if the same UR was input to both *na.ture* and *natur-al* as is the case by its standard definition (UR defined as the common input to all allomorphs of the same morpheme), then *natur-al* should also have a long vowel. Hence just supplementing IO-FAITH with OO-FAITH is not sufficient in this case. Rather, IO-FAITH as faithfulness to a UR must be removed from the scene altogether, and the only principled way to do so is to drop the already unnecessary UR. Hence, *na.ture* is faithful to its own input with

whatever rank the language at large has. The form *natur-al* is also faithful to its input, but that input (except for *-al*) is the word *na.ture* and not a UR, and that ranking is determined by the particular morphological system, not the language at large. Affixes like *-al* of (25), which are relatively unproductive and prone to idiosyncrasy, evidently establish relatively weak/ low-ranked associations.

The notion of ‘cyclic’ derivation would therefore have seemed right here in a way, requiring that *na.ture* be derived from a UR, while *natur-al* would be derived from *na.ture*. But such notion has turned out to be right only when it reproduces (in a more complicated way), the effects of just dropping the UR from the theory, which also forces reference to surface forms. In other respects, the cycle, and its cluster of attribute properties, proves to have been incorrect as Kiparsky (1993) showed in part. This is true in particular of the association ‘cyclic = lexical’ (see discussion in Kenstowicz 1994, 195 ff.). The notion ‘lexical’ refers to the presence of idiosyncrasy, almost by definition, while the property ‘cyclic’ identifies, by its core definition, preservation of phonological structure as in *cond[ɛ]nsation* (19a) above. As argued for (23), it turns out that such preservation is massive with Germanic/ Level 2 affixes (no changes compared with the base word). This would make them ‘cyclical’. But idiosyncrasy is absent from those affixes, which would make them ‘non lexical’ (i.e. more like phrasal constructs). Conversely, Latinate/ Level 1 affixes would be part of the ‘lexical’ morpho-phonology in virtue of the noted idiosyncrasies, but the preservation effects they generate are in fact very limited, *cond[ɛ]nsation* notwithstanding, making them only marginally ‘cyclic’. As argued in Burzio (1991, 1993, 1994), such effects consist of only minimal distortions of the standard footing, as in e.g., *phe(nòme)nólogy* (to match *phenómenon*), or *américa(nistø)* (to match *Américan*). As in

underived items, adjacent stresses are ruled out, for example, as in *càtastrophic*, *informatiòn*, *cònsultation* (*catástrophe*, *inforèm*, *consùlt*). This contrasts with the more robust distortion of cases like (23a) *éffort-less-ness*. As for the apparent preservation of stress in *cond[ε]nsation* of (19a), it is argued in Burzio (1994, 185) to only concern the details of vowel reduction rather than stress, though the relation with *condénse* remains relevant.

This means that, when faithfulness to a base word specifically refers to stress, it is relatively low ranked for the Latinate affixes, consistently with (25b) above, but not so low-ranked as to be totally ineffective. This accentual faithfulness, referred to as ‘Metrical Consistency (MC) in Burzio (1994) is now what accounts for the exceptions to vowel shortening, as illustrated in (26).

- (26) a. desí:rous, adhé:rent, extrémist, diví:sive, médità:tive, ...
b. blásphemous, áspirant, hýpnotist, rélatiive, génerative, ...
c. MC, *V: >> IDENT (V-length)

The hierarchy in (26c) is in turn dominated by constraints mandating well-formed metrical feet which exclude, in particular, stress on light penultimate syllables. This means that when a long vowel and the stress of the base word both end up in a penultimate syllable in a derivative, as in all of the cases in (26a, b), the two leftmost constraints in (26c) cannot both be satisfied. Either the vowel will have to fail to shorten as in (26a), or the stress of the base will be lost, as in (26b). The variation between the cases in (26a) and those in (26b) reveals that the grammatical system is indeterminate on the relative ranking of the two leftmost constraints in (26c), allowing lexical

information to choose outcomes (see Burzio 2006 and refs.). The effect observed for some of (15) above may also be at work, however. That is, items that are semantically very close to their base may end up accentually faithful as well, with no shortening.

In sum, the major class of exceptions to vowel shortening finds the principled account in (26c), leading to the conclusion that vowel-shortening is -on its own- perfectly general (further scattered exceptions aside). This is then a case of what is referred to in the OT literature as ‘The Emergence of The Unmarked’ (TETU; McCarthy 2002, 129 ff.), well known from the study of reduplication, where reduplicant morphemes often also exhibit relatively less marked structures (McCarthy and Prince 1994). This effect has been obtained here by taking morphological relations to be faithfulness relations in OT (and like others, reducible to entailments), whose rank is tied to the regularity and productivity of the specific morphological system rather than determined for the language at large, and by rejecting the notion of UR that would compromise such an account.

This ‘TETU’ account would seem to safely extend to the cases in (8) above that also, at least *prima facie* seem to adopt less marked structures in morphologically derived environments without any further reference to context.

There are no alternatives to this account of vowel shortening except those based on the traditional, but -as I have argued- faulty assumption that this phenomenon is limited to phonologically definable (e.g. ‘trisyllabic’ or other) contexts. Such accounts would also not directly extend to the cases in (8).

References

- Benua, L. (1997) *Transderivational Identity: Phonological Relations between Words*, Ph.D. Dissertation, U. Mass. Amherst.
- Bolognesi, R. (1998) *The phonology of Campidanian Sardinian: A unitary account of a self-organizing structure*. Ph.D. dissertation, HIL. [Printed by ICG Printing, Dordrecht.]
- Burzio, L. (1991) 'On The Metrical Unity of Latinate Affixes,' in Germán Westphal, Benjamin Ao, and Hee-Rahk Chae, eds. *Proceeding of the Eighth Eastern States Conference on Linguistics*, Department of Linguistics, Ohio State University, 1-22. Reprinted in *Rivista di Grammatica Generativa* 16, 1-27.
- Burzio, L. (1993) 'English Stress, Vowel Length and Modularity,' *Journal of Linguistics*, 29.2, 359-418.
- Burzio, L. (1994) *Principles of English Stress*, Cambridge University Press.
- Burzio, L. (1996) 'Surface Constraints versus Underlying Representation,' in: Durand, Jacques & Bernard Laks (eds.) *Current Trends in Phonology: Models and Methods*. European Studies Research Institute, University of Salford Publications. (123-141)
- Burzio, L. (1998) 'Multiple Correspondence', *Lingua* 103, 79-109.
- Burzio, L. (2000a) 'Cycles, Non-Derived-Environment Blocking, and Correspondence,' in Joost Dekkers, Frank van der Leeuw and Jeroen van de Weijer, eds. *Optimality Theory: Phonology, Syntax, and Acquisition*. Oxford University Press, 47-87.
- Burzio, L. (2000b) 'Segmental Contrast meets Output-to-Output Faithfulness', *The Linguistic Review* 17, 2-4, 368-384.

- Burzio, L. (2002a) 'Missing Players: Phonology and the Past-tense Debate,' *Lingua* 112, 157-199.
- Burzio, L. (2002b) 'Surface-to-Surface Morphology: when your Representations turn into Constraints' in P. Boucher (ed.) *Many Morphologies*, Cascadilla Press. 142-177.
- Burzio, L. (2005) 'Sources of Paradigm Uniformity', in Laura J. Downing, T. A. Hall, Renate Raffelsiefen, eds. *Paradigms in Phonological Theory*. Oxford: Oxford University Press: 65-106.
- Burzio, L. (2006) 'Lexicon Versus Grammar in English Morphophonology: Modularity Revisited' *Korean Journal of English Language and Linguistics* 6-3, 437-464.
- Burzio, L. (2007) 'Phonologically conditioned syncretism', in *Selected Proceedings of the 5th Décembrettes: Morphology in Toulouse*, ed. Fabio Montermini, Gilles Boyé, and Nabil Hathout, 1-19. Somerville, MA: Cascadilla Proceedings Project.
<http://www.lingref.com/cpp/decemb/5/index.html>
- Burzio, L. and N. Tantalou (2007) 'Modern Greek Accent and Faithfulness Constraints in OT', *Lingua*, Vol 117/6 pp 1080-1124.
- Chomsky, N. and M. Halle (1968) *The Sound Pattern of English*, Harper and Row, New York.
- Chung, S. (1983) 'Transderivational Relationships in Chamorro Phonology,' *Language* 59, 35-66.
- Cole, J. (1995) 'The cycle in phonology,' in J. Goldsmith (ed.) *The Handbook of Phonological Theory*, B. Blackwell 72-113.
- Flemming, E. (1995) *Auditory Representations in Phonology* Ph.D. Dissertation, UCLA. .
Revised version by Garland Press, NY (2001).
- Flemming, E. (2003) 'The relationship between coronal place and vowel backness', *Phonology*

20, 335-373.

Flemming, E. (2008) 'Asymmetries between assimilation and epenthesis', ms, MIT.

Fukazawa, H. (1998) *Theoretical Implications of OCP Effects on Features in Optimality Theory*,
Ph.D. Dissertation, University of Maryland, College Park.

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

Hansson, G. Ó. 2001. Theoretical and typological issues in consonant harmony. Ph.D.
dissertation, University of California, Berkeley.

Hulst, H. G., van der & Weijer, J. M., van de (1995) 'Vowel Harmony'. In J.A. Goldsmith (Ed.),
Handbook of Phonological Theory, pp. 495-534. Oxford: Basil Blackwell.

Inkelas, S. and C.O. Orgun (1995) 'Level Ordering and Economy in the Lexical Phonology of
Turkish,' *Language*, 71.4, 763-793.

Itô, J. (1990) 'Prosodic Minimality in Japanese,' *Syntax Research Center, Cowell College,*
UCSC, Technical Report SRC-90-04.

Iverson, G., and D. Wheeler (1988) 'Blocking and the elsewhere condition,' in M.Hammond and
M. Noonan , eds. *Theoretical Morphology*, San Diego, CA: Academic Press. pp.325-338.

Kenstowicz, M. (1994) *Phonology in Generative Grammar*, Cambridge, Massachusetts:
Blackwell.

Kenstowicz, M., and J. Rubach (1987) 'The Phonology of syllabic nuclei in Slovak', *Language*
63, 463-497.

Kiparsky, P. (1973) 'Abstractness, opacity and global rules,' in O.Fujimura, ed. *Three*
Dimensions of Linguistic Theory, TEC, Tokyo, 57-86.

Kiparsky, P. (1982) 'Lexical Phonology and Morphology,' in I.S. Yang ed. *Linguistics in the*

- Morning Calm*, 3-91. Seoul: Hanshin.
- Kiparsky, P. (1993) 'Blocking in Non-derived environments,' *Phonetics and Phonology 4: Studies in Lexical Phonology*, Sharon Hargus and Ellen Kaisse, eds. 277-313. San Diego: Academic Press.
- Kirchner, R. (1996) 'Synchronic Chain shifts in Optimality Theory', *Linguistic Inquiry* 27:2, 341-350.
- Kula, N. C. (2008) 'Derived environment effects: A representational approach', *Lingua* 118, 1328–1343.
- Liljencrants, J. and B. Lindblom (1972) 'Numerical simulations of vowel quality systems: the role of perceptual contrast', *Language*, 48, pp. 839-862.
- Łubowicz, A. (1999) 'Derived Environment Effects in OT'. In the *Proceedings of the West Coast Conference on Formal Linguistics 17*. ed. Kimary N. Shahin, Susan J. Blake, and Eun-Sook Kim, pp. 451-65. Stanford, CA: CSLI. (Available online at: <http://roa.rutgers.edu/index.php3>)
- Lubowicz, A.. 2002. Derived Environment Effects in Optimality Theory. In *Lingua* 112, 243-280.
- Łubowicz, A. (2003) 'Local conjunction and comparative markedness', *Theoretical Linguistics* 29, 101–112.
- Mascaró, J. (1976) *Catalan Phonology and the Phonological Cycle*, MIT Doctoral Dissertation. Reproduced (1978) by the Indiana University Linguistics Club, Bloomington.
- McCarthy, J. and A. Prince (1994) 'The Emergence of the Unmarked: Optimality in Prosodic Morphology,' in Mercè González (ed.), *Proceedings of the North East Linguistic Society* 24. Amherst, MA: Graduate Linguistic Student Association. 333-379.

- McCarthy, J. (2002) *A Thematic Guide to Optimality Theory*, New York: Cambridge University Press.
- McCarthy, J. (2003) 'Comparative markedness', *Theoretical Linguistics* 29, 1-51.
- Pater, J. (1999) 'Austronesian nasal Substitution and Other NC Effects', in René Kager, Harry van der Hulst, and Wim Zonneveld (eds), *The Prosody Morphology Interface*, Cambridge University Press, 310-343.
- Prince, A., and P. Smolensky (1993) *Optimality Theory: Constraint Interaction in Generative Grammar*, Report no. RuCCS-TR-2. New Brunswick: Rutgers University Center for Cognitive Science. Published (2004): Blackwell.
- Poser, W. (1982) 'Phonological representations and action-at-a distance', in van der Hulst, H. and N. Smith eds. *The Structure of Phonological Representations*, Part 2, 121-158. Dordrecht: Foris.
- Poser, W. (1993) 'Are Strict Cycle Effects Derivable?,' *Phonetics and Phonology 4: Studies in Lexical Phonology*, Sharon Hargus and Ellen Kaisse, eds. 277-313. San Diego: Academic Press.
- Prince, A. (1975) *The Phonology and Morphology of Tiberian Hebrew*. Ph.D. Dissertation, MIT.
- Rose, S. and R. Walker (2004) 'A Typology of Consonant Agreement as Correspondence', *Language* 80-3, 475-531.
- Rubach, J. (1984) *Cyclic and lexical phonology: The structure of Polish*. Dordrecht: Foris.
- Rubach, J. (1993) *The lexical phonology of Slovak*. New York: Oxford University Press.
- Rubach, J. (1995) 'Representations and the organization of rules in Slavic phonology'. In: J.A. Goldsmith (ed.), *The handbook of phonological theory*, 848-866. Cambridge, MA: Blackwell.

Steriade, D. (1994) 'Positional Neutralization and the Expression of Contrast,' ms. UCLA.

Steriade, D. (1999) 'Lexical Conservatism in French Adjectival Liaison,' in B. Bullock, M.

Authier and L. Reed (eds.) *Formal Perspectives in Romance Linguistics*, John Benjamins, pp. 243-270.

Steriade, D. (2001) 'The Phonology of Perceptibility Effects: the P-map and its consequences for constraint organization', ms. UCLA

Wayment, A., L. Burzio, D. Mathis, R. Frank (2007) 'Harmony versus Distance in Phonetic Enhancement', in Emily Elfner and Martin Walkow (eds), *Proceedings of NELS 37*.

GLSA Publications, Amherst. MA.

Wayment, A. (in preparation) *Subsymbolic Phonology: An Attraction-based Perspective on Long-distance Interaction*, Ph.D. dissertation, Johns Hopkins University.

Wilson, C. (2000) *Targeted Constraints: An Approach to Contextual Neutralization in Optimality Theory*, Ph.D. Dissertation, Johns Hopkins University.

Wilson, C. (2001) 'Consonant Cluster Neutralization and Targeted Constraints', *Phonology* 18.1, 147-197

LUIGI BURZIO
Department of Cognitive Science
Johns Hopkins University
Baltimore, MD 21218
USA
burzio@jhu.edu
ph: (410) 516-7214
fax:(410) 516-8020

Luigi Burzio is Professor of Cognitive Science at the Johns Hopkins University, and has previously taught at Harvard University. He is the author of *Italian Syntax* (Kluwer, 1986) and *Principles of English Stress* (Cambridge UP, 1994). His interests include theoretical syntax, phonology and morpho-phonology interaction.