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Derived environment effects: A representational approach

Nancy C. Kula

University of Essex, United Kingdom

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Abstract

Derived environment effects involve either overapplication or underapplication of phonological rules in phonological or morphological environments. This paper focuses on underapplication effects in both phonological and morphological environments, which are treated as resulting from representational differences between derived and non-derived environments at the appropriate level. The Government and Dependency Phonology notions of head and dependent are utilised to this end. Thus, phonologically derived environment effects result from melodic structure that differentiates branching from immediate dominance relations between elements, allowing phonological processes to target a segment of one melodic configuration to the exclusion of another. Morphologically derived environment effects, on the other hand, involve representational differences at the constituent structure level, corresponding to the fact that morphological effects are a result of junctural or morpheme-integrity effects. In the latter case, head-dependent relations are defined as holding over domains, thereby differentiating affixal from non-affixal material, while in the former junctural effects the representational difference is defined at the CV tier, with phonological processes being sensitive to the presence of empty V and C positions.
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1. Introduction

This paper takes up the topical issue of derived environment effects, which has in recent times seen a resurgence in the Optimality Theory (OT) literature (Burzio, 1998; Goldrick, 2000; Łubowicz, 2002; McCarthy, 1999, 2003, 2005; van Oostendorp, 2007); see also Kiparsky (1993), Inkelas (1998) and Bye (2002) for discussion in other frameworks. The discussion involves revisiting an old problem highlighted in Kiparsky's (1973:79) definition of opacity, where he

E-mail address: nckula@essex.ac.uk.

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treats it as being of essentially two types. Either a phonological process fails to apply even though its context is met (apparent underapplication, counterfeeding opacity), or it applies even though its context is not met (apparent overapplication, counterbleeding opacity). Derived environment effects are a case of the former, in that they restrict phonological rules to applying only in derived environments, while non-derived environments present a case of underapplication. Derived environments can be either phonological or morphological. Morphologically derived environments involve phonological rules applying at morphological junctures or boundaries, while phonologically derived environments may have a monomorphemic target, some part of which must have undergone an earlier phonological rule.

Such apparent mismatches can easily be accounted for in phonological approaches that have recourse to rule ordering by, for example, utilising the Strict Cycle Condition as in Kiparsky (1982). On the other hand, any theory that has no such notion faces a challenge in handling such effects. This paper proposes to tackle derived environment effects in terms of representation from a derivational non-rule ordering perspective, drawing insights from Government and Dependency Phonology.[1] The opposing behaviour of derived and non-derived elements is treated as resulting from a difference in representation at either the melodic level – in terms of internal melodic structure organisation – or at the constituent structure level.

In section 2 the paper presents the main proposal, which is then applied to phonologically derived environments in section 3. Morphologically derived environments (section 4) are seen on the one hand to utilise the same basic principle as phonologically derived environment effects, but also on the other to require a solution that is sensitive to their morphological complexity. Some concluding remarks are presented in section 5.

2. Derived environment effects as melodic structural effects

The question which this paper aims to address is why two segments that look identical on the surface and both belong to language L are unable to undergo a phonological rule applying in language L, where one of the segments is derived and the other lexical. Only the former undergoes the rule. Consider for illustration the Kinyamwezi data in (1), where palatals may either be derived or lexical.[2] Palatalisation in (1a) in the causative forms is the surface effect of causation, with no causative suffix occurring independently.

(1) Palatalisation: /s k n/ → [ʃ tʃ ŋ]

a.	verb root + FV			causative	b.	Non-derived palatals	
	bis-a	‘hide’	→	biʃ-a		buutʃa	‘carry’
	bak-a	‘light’	→	batʃ-a		liiʃa	‘kill’
	bon-a	‘see’	→	bonj -a			

Derived environment effects are seen in the application of an OCP effect that disallows a sequence of palatals. For the derived palatals in (1a) the OCP takes effect just in case a following

[1] This is a further development of ideas presented in a paper in SOAS Working Papers in Linguistics 14 (Kula, 2006).

[2] Kinyamwezi is a Bantu language of Tanzania. Data are drawn from Maganga and Schadeberg (1992). Verbal suffixation in Bantu languages generally involves a -VC- shaped suffix attaching to a root (usually CVC-). The final vowel (FV) that appears in all verb forms is placed after any suffixes. If the suffix ends in a vowel (i.e. -VCV or -V), the FV is overridden (see the perfective forms in (2)).

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suffix also undergoes palatalisation. This results in depalatalisation of the root-final consonant, as seen in the causative + perfective forms in (2a). In contrast to this, root-final non-derived palatals show no OCP effects in (2b), where a sequence of palatals surfaces.[3]

(2)	a.	Palatal OCP			
		causative	causative+perfective		
		biʃ-a	biʃ-ile	→ bis-ije	*biʃ-ije
		batʃ-a	batʃ-ile	→ bak-ije	*batʃ-ije
		bonj -a	bonj-ile	→ bon-ije	*bonj-ije
	b.	Non-derived palatals: no palatal OCP			
		buutʃ-a	buutʃ-ile	→ buutʃ-ije	
		liiʃ-a	liiʃ-ile	→ liiʃ-ije	

As seen in (2a), the palatals of the causative forms revert back to their non-palatal forms when the perfective *-ile*, which itself undergoes palatalisation, is added.[4] The palatalisation of the perfective suffix from *-ile* to *-ije* can be regarded as resulting from a palatal feature spreading from the root-final consonant, which then undergoes depalatalisation in (2a) but not in (2b).

The proposal here is to derive this contrast from a representational difference in melodic structure between derived and non-derived palatals. Taking melody as composed of elements – on a par with features – under Government Phonology assumptions, combinations of elements that make up specific segments are viewed as being organised in head-dependent relations. Thus, while the palatalising I-element in derived palatals is in an adjoined or branching dependent position to the rest of the phonological expression, in non-derived palatals it is in an immediately dominated position. Consider the graphic representation of this in (3).[5]

(3)	a. Derived palatal	b. Non-derived palatal
	[tʃ]	[tʃ]
L/H line	H	H
ʔ/h line	ʔ	ʔ
R/I line	I	I

[3] The inability of lexical palatals to trigger OCP can also be gleaned from the absence of the effect within the root in causative forms of verb roots containing lexical palatals, as in [ʃook-a] 'go back', which becomes [ʃooʃ-a] 'cause to go back', for example.

[4] The form of the perfective suffix is taken to be *-ile* because it occurs in this form in all cases when a palatal does not precede it. The palatalisation and depalatalisation facts of Kinyamwezi are slightly more complex than these data suggest, with alveolars and velars giving identical outputs under palatalisation but converging on the velar inputs in the depalatalisation process. See Hyman (in press) and Kula (in press) for differing detailed analyses. The data given will suffice for the present exposition.

[5] I assume Strict CV phonology (Lowenstamm, 1996; Scheer, 2004) and the element set (A I U L H h ʔ R), represented on autosegmental lines distinguishing voice (L H), manner (ʔ h) and place (R I U A).

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There is thus a representational difference between a lexical [tʃ] and one that has /k/ as its source, which is basically a velar stop that has acquired an I-element in the course of the derivation.[6] Palatal OCP will target the structure in (3a), to the exclusion of that in (3b). We return to the actual analysis of Kinyamwezi palatal OCP presently, after further motivation of the differing structures in (3) in a representational framework.

2.1. Motivating structural differences

The structures in (3), which differentiate a derived from a non-derived palatal, consist of the same set of elements, differing only in their organisation. The idea of the same elements assuming different positions in dependency relations is independently motivated in Government and Dependency Phonology, but is used there to capture contrast between segments. Thus in Kula (2002) the L-element in head position contributes nasality to a segment, while its occurrence in dependent position contributes voicing. The idea of differing dependency positions, i.e. immediate dominance (3b) vs. branching dependency (3a), is further developed in Botma's (2004) articulated theory of element dependency. Here too, as generally assumed in element geometries, a difference in phonological representation equates to a difference in phonetic output, so that the difference between a tense and lax front mid vowel is, for example, that the I-element is in an immediate dominance relation with the A-element in the former case but in a branching dependency relation with A in the latter. The primary motivation for such shifting dependency relations is to capture the required set of contrasts for a particular language, while retaining a relatively small set of elements or features within the model. Thus the model allows for differing dependency relations independently, i.e. for the expression of contrast.[7]

The availability of such structures raises the question of whether they have any other motivation, in the form of phonological processes, say, or indeed, whether these structures are employed in other ways. If so, the use of such structures comes at no further cost to the model, since they are independently needed to capture contrasts that may be either simple or complex. The use of differing dependency relations to capture derived vs. non-derived segments in languages that need to employ this distinction is not ad hoc, as it draws on resources already available in the model. The presence of effects which are different in derived as opposed to non-derived segments provides the evidence that motivates this distinction. In fact, the use of differing dependency relations to capture derived environment effects is also used with reference to capturing a contrast between segments that is not manifested at the phonetic level, but at a more deeply embedded phonological level. In this case, phonological entities consisting of the same components with different structural organisations converge on an identical phonetic form. It is the presence of these structures within Dependency and Government Phonology that I will employ to tackle derived environment effects in a range of languages. The choice of the branching dependency structure rather than the immediate dominance structure to represent the derived segment in (3a) follows from the usual use of branching dependency to represent those

[6] This is under the assumption that velar place is empty, as proposed in Rennison (1997). This is not crucial to the analysis, but allows for a sharper comparison between the two structures. Note that the ability to have different representations for derived vs. non-derived segments is not tenable in versions of Government Phonology where no structure below the CV tier is assumed.

[7] While the use of element geometries in the spirit of feature geometry (Clements, 1985; Clements and Hume, 1995; etc.) is articulated only in later Government Phonology work (Brockhaus, 1995; Kula, 2002) the conception of the idea is already seen in earlier work, where elements have head or operator status in the elemental representation of a segment.

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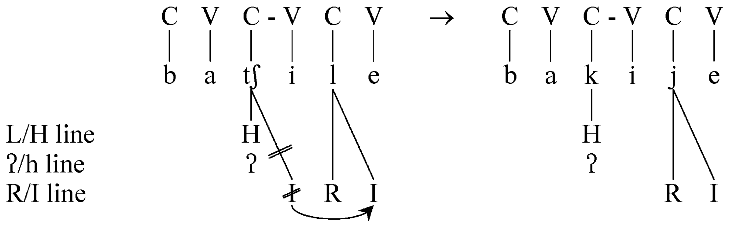
features that form the outer shell of the core part of a segment, such as nasality (represented by the L-element in branching dependency), aspiration (the H-element in branching dependency), glottalisation (the ʔ-element in branching dependency) and palatalisation (the I-element in branching dependency). This, however, by no means implies that branching dependency structures may not be lexical. This is an issue which must be decided on a language-to-language basis, and is naturally dependent on the contrasts expressed in the language under investigation.

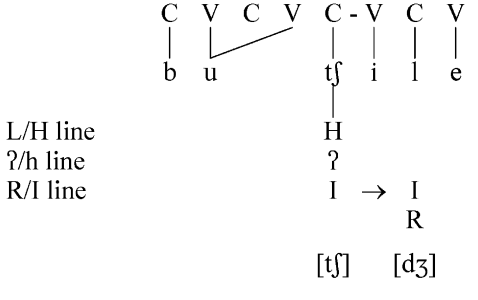
2.2. *Kinyamwezi palatal OCP*

As discussed in section 2, Kinyamwezi displays derived environment effects in the application of palatal OCP to the derived vs. non-derived structures in (3), as shown in the data in (2). The spreading of the I-element from the two palatal types proceeds differently, owing to the different dependency positions. In a branching dependency, the palatalising I-element is delinked from the other elements, and spreads to the next segment, where it also assumes a branching dependency position. One could also assume that both the branching dependency structure and the element attached to it are delinked, and that this is the reason for the I-element also being in a branching dependency in the subsequent new palatal (of the perfective suffix), as shown in (4a). The delinking of the branching dependency structure with its I-element gives the surface effect of OCP, as the segment from which the I-element is lost now lacks the palatal feature. The immediate dominance structure in (3b), on the other hand, spreads the I-element while retaining its position (i.e. with no delinking) and thereby fails to show OCP effects; rather, two palatals surface in a sequence, as shown in (4b).

(4) a. Derived palatals: OCP (batʃ-ile → bak-ije, *batʃ-ile ‘has made hide’)



b. Non-derived palatals: no OCP (buutʃ-ile → buutʃ-ije ‘has made carry’)



In (4a) the I-element in a branching dependency is displaced to the following target of palatalisation (the consonant of the perfective suffix) and being so displaced, the root-final

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palatal can no longer be palatal, as it has lost the palatalising I-element; [tʃ] thus reverts to [k]. The suffix consonant [l] becomes [dʒ] on addition of the I-element in a branching dependency. The palatal I-element in an immediate dominance relation in (4b) spreads to the following suffixal consonant. No delinking takes place, and there is no palatal OCP effect.[8]

The derived environment effect manifested in the restricted application of OCP only to derived palatals is therefore accounted for here as a result of the difference in the structural representation of the phonological expressions of derived vs. non-derived (lexical) palatals, using the mechanisms of immediate vs. branching dependency, independently motivated in Government and Dependency Phonology.[9]

The remainder of this paper will show that the general notion of a melodic structural difference can be called upon in other cases of phonologically derived environment effects. Morphologically derived environment effects will also follow from a difference in representation at the appropriate level, i.e. at the constituent structure or CV level. The following sections are dedicated to the discussion of widely known derived environment effects, showing how these can be handled by drawing on representational differences. Section 3 presents phonologically derived environments and section 4 morphologically derived environments. Note, though, that the examples that will be considered merely serve to illustrate the viability of the approach; the full set of elemental combinations that capture the set of consonantal and vocalic contrasts in the languages discussed remains to be fully worked out.

3. Phonologically derived environments

Łubowicz (2002) presents interesting data with respect to phonologically derived environment effects which she accounts for in OT with constraints that conjoin a markedness constraint on the locus of change with a faithfulness constraint on the intermediate output of a phonological rule (see Łubowicz, 2002 for details). I consider here how three of these cases can be analysed under the proposed representational account.

3.1. Polish first velar palatalisation and spirantisation

The Polish data of interest here are very similar to the Kinyamwezi data already discussed. In Polish, a process known as first velar palatalisation derives palatals from velars. A following high vowel can be considered the trigger. A subset of these derived palatals (the voiced ones) is then subject to a process of spirantisation, which does not apply to non-derived (voiced) palatals.

[8] We leave aside the discussion of the element combination (R.I) (instead of (ʔ.L.R.I), for example) being interpreted as the voiced palatal [dʒ], as it goes beyond the scope of this paper, but see Kula (2005) for discussion of elemental representations involving mismatches where different element combinations represent the same phonetic output and their resolution.

[9] A reviewer raises the question whether the difference between derived and lexical segments should hold for all segments in all languages, and indeed whether this should apply across the board in languages with derived environment effects, so that in these languages all derived segments (whether or not they trigger derived environment effects) should be different from their lexical congeners. The former position is probably too strong, even though evoking it (under some formulation of well-formedness conditions) does not entail that derived environment effects must apply, even though they of course may. I am also wary of the latter position: just as the characterisation of contrasts in a language does not entail the exhaustive use of the two dependency relations for every segment, it may equally be too strong to assume that every derivation results in a representation different from the lexical one.

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Consider the data in (5) taken from Łubowicz (2002; see also Rubach, 1984 for extensive discussion of these data).

(5) First velar palatalisation spirantisation

a.	kro[k]-i-c	→ kro[tʃ]-y-ć		'to step'
b.	stra[x]-i-c	→ stra[ʃ]-y-ć		'to frighten'
c.	wa[g]-i-c	→ wa[dʒ]-i-ć	wa[ʒ]-y ć	'to weigh'
Non-derived palatals: no spirantisation				
d.	bry[dʒ]-ik-ɨ	→ bry[dʒ]-ek-ɨ	*bry[ʒ]-ek-ɨ	'bridge'
e.	ban[dʒ]-o	→ ban[dʒ]-o	*ban[ʒ]-o	'banjo'
f.	[dʒ]em-ɨ	→ [dʒ]em-ɨ	*[ʒ]em-ɨ	'jam'

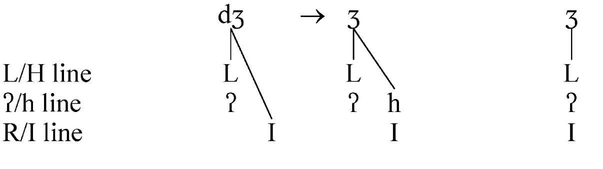
We see in (5a, b) that the voiceless velars palatalise to their corresponding voiceless palatals, which do not undergo a further process of spirantisation. In contrast to this, the voiced velar in (5c) palatalises and undergoes spirantisation. Derived environment effects are seen in (5d–f), where non-derived voiced palatals fail to undergo spirantisation, in contrast to (5c).

We can treat spirantisation as introducing frication, represented by the h-element. Given that this only happens in cases where palatalisation has taken place, the insertion of the h-element has to be regarded as parasitic on I-adjunction or a branching dependency structure, so that non-derived palatals are immediately removed from the equation, giving us the desired derived environment effects. Spirantisation applies to only those structures that have the I-element in a branching dependent position with its triggering h-element also attaching to this dependent position, as shown in (7a). An overarching constraint will be that the L-element (denoting voicing) must also be present, as only voiced palatals are affected. While leaving out the full details of the representation of Polish consonants, we can thus tentatively characterise the conditions of spirantisation as in (6):

(6) Constraints on spirantisation
Adjoined I attracts h: spirantisation targets a branching dependent position
h and H do not combine: spirantisation does not affect voiceless segments

(6) is manifested in (7a), as opposed to (7b).

(7) a. Spirantisation: dʒ → ʒ b. No spirantisation



As seen in (7b), non-derived palatals do not have a branching dependent position and hence cannot undergo spirantisation; they fail to meet the melodic structural configuration that is the target of spirantisation. The difference in representation can thus be seen to explain the derived environment effects observed.

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3.2. Slovak diphthongisation

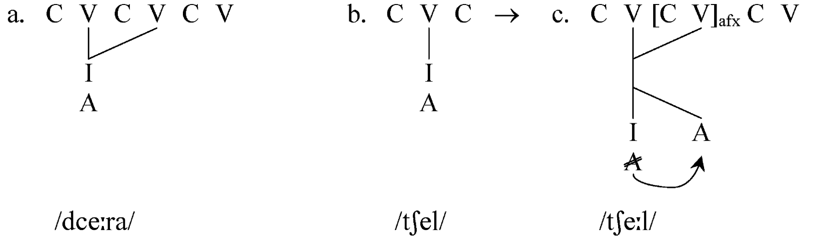
In Slovak, two rules, vowel lengthening and diphthongisation, are in a feeding relation that results in a derived environment effect when non-derived long vowels fail to undergo diphthongisation (see Kenstowicz and Rubach, 1987; Rubach, 1993 for details). Vowel lengthening is triggered by certain affixes, which are analysed as consisting of a lexical mora. I adopt this analysis for the current discussion, assuming that the relevant affix involves the addition of an empty CV. The diphthongisation process only targets mid vowels and /æ/. Thus is (8a) the high vowel /i/ undergoes lengthening but no diphthongisation, in contrast to /e o æ/ in (b–d), which undergo lengthening followed by diphthongisation. In contrast to this, the lexical mid vowels of contemporary Slovak in (e, f) show derived environment effects by failing to undergo diphthongisation. The data here are taken from Rubach (1995:849) and Kenstowicz and Rubach (1987:470).

(8)

			vowel lengthening		diphthongisation	
a.	p[i]v+CV_{affix}	→	p[iː]v			‘beer’
b.	tʃ[e]l+CV_{affix}	→	tʃ[eː]l	→	tʃ[ie]l	‘forehead’
c.	ʃ[o]p+CV_{affix}	→	ʃ[oː]p	→	ʃ[uo]p	‘shed’
d.	m[æ]s+CV_{affix}	→	m[aː]s	→	m[ia]s	‘meat’
	Non-derived long vowels: no diphthongisation					
e.	dr[eː]n	→	dr[eː]n	‘drain’		
f.	m[oː]d-a	→	m[oː]da	‘fashion’		

As in the previous cases, we want to derive the difference between derived vs. non-derived long vowels from a melodic structural difference. Long vowels that are the target of diphthongisation will involve a branching dependent in their representation (9c), as opposed to (9a). (9a) is a representation of two elements (defining the mid vowel) in a dominance relation, occupying two V positions on the CV tier. In contrast, the derived long vowel in (9c) starts out as a short vowel, as in (9b), with elements in a dominance relation undergoing decomposition by the A-element shifting to the newly added empty position, here denoted by an empty CV. In the initial stage the two elements remain part of the same expression – with the A-element now in a branching dependency position – and are simultaneously pronounced as a long front mid vowel. This results in the long vowel representation in (9c) for the derived long vowel, as opposed to the non-derived one in (9a).

(9) Non-derived long vowel   Long vowel derived from short vowel



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Of these two long vowel representations diphthongisation affects (9c) and not (9a), quite naturally portraying the fact that diphthongisation is a result of gradual decomposition. In this sense, diphthongisation involves the further displacement of an element that is already in a branching dependent position, i.e. it is not part of the core representation. Thus the A-element detaches totally from its dependent position and independently occupies the V position of the affix. A further point that we must consider, given the lengthening data in (7a) (/piv/ → [piːv] 'beer'), is that the I-element spreads into a following affixal position. We expect that this spreading will also take place in diphthongisation resulting in the final output [tʃiel] 'forehead'. The latter spreading process also expresses an important difference between heads and dependents, in that while a dependent can be detached from a representation and hence spread without a trace (A-element in diphthongisation), a head cannot (I-element in both lengthening and diphthongisation).

3.3. Lenition in Campidanian Sardinian

Bolognesi (1998) discusses voicing and lenition phenomena in Campidanian Sardinian which provide a further example of phonologically derived environment effects. In Campidanian Sardinian, a postvocalic voicing rule voices obstruents, after which voiced stops (and affricates) further undergo lenition. As should by now be expected, non-derived voiced stops do not undergo lenition, providing a case of a derived environment effect. Consider the data in (10).

(10)	a.		post-vocalic voicing		lenition	
		sːa [f]amilːia	→ sːa[v]amilːia			'the family'
		bɛlːu [p]iʃːi	→ belːu [b]ishːi	→	bɛlːu[β]iʃːi	'nice fish'
		dɛ [k]uatːru	→ dɛ [g]uatːru	→	dɛ [ɣ]uatːru	'of four...'
	b.	non-derived stops: no lenition				
		sːa [b]ia	→ sːa [b]ia	'the road'		
		sːu [g]atu	→ sːu [g]atu	'the cat'		

In (10a), voiced obstruents result from postvocalic voicing. Voiced stops undergo a further process of lenition, as opposed to the non-derived voiced stops in (10b), which do not. Similarly to the Polish data with regard to the palatalising I-element, we can treat the voicing L-element as being in a branching dependent position in derived voiced obstruents; further, this is the structural configuration under which lenition applies. Thus non-derived voiced stops are targets (11b), while derived ones are not (11a). Lenition is treated as addition of the frication enhancing h-element.

(11)	a. Derived voiced stop: lenition	b. Non-derived voiced stop: no lenition
	b	b
L/H line	L	L
ʔ/h line	ʔ	ʔ
R/I line	U	U

Fricatives that already contain the h-element get no further h-element, despite meeting the structural conditions of lenition, and therefore do not show lenition effects.

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It has been demonstrated in the foregoing that reference to melodic structural differences between derived and non-derived segments in phonologically derived environments can be used to account for the observed derived environment effects where non-derived segments are immune to the processes that their derived congeners undergo. The solutions adopted here in terms of the characterisation of palatalisation, spirantisation, lenition, vowel lengthening and diphthongisation are standardly assumed and independently motivated in a range of work in Government Phonology. Palatalisation is treated as involving spread of the I-element in Cristófaro-Silva (2003), Cooke (2000) and Kula (2002); spirantisation is treated as an influence of the h-element in Scheer (2003); lenition is treated as involving the loss of the ʔ-element and promotion of the h-element in Harris (1994); and the decomposability of complex vocalic expressions assumed for the Slovak diphthongisation is seen in the treatment of various vowel harmony, fusion and coalescence processes in Lowenstamm and Kaye (1986), Harris and Lindsey (2000), Charette and Göksel (1994), etc.

Notwithstanding the absence of fully worked out segment inventories and the licensing constraints that derive them, the foregoing suffices to illustrate the viability of the proposed approach. Let us now consider a few cases of morphologically derived environment effects and see if these too can be shown to follow from structural differences.

4. Morphologically derived environments

There are two kinds of morphologically derived environment effects which can be distinguished in morphologically complex stems; one kind restricts processes to applying only at morpheme boundaries, the other applies only to the stem or the affix. I will consider these two types of morphologically derived environments separately, for reasons that will become clear presently. I start with cases where particular phonological processes only apply at morpheme junctures.

4.1. Junctural effects

Inkelas (1998) discusses a process of Turkish velar deletion which deletes stem-final velars when an affix is added. She discusses these data in the context of developing an analysis of morphologically derived environment effects, preferring the more appropriate term *non-derived environment blocking*. Her analysis, which will not be discussed here, utilises a notion of structural immunity by which segments may or may not be prespecified for particular features. Archiphones, underspecified for particular features, can then be subject to the acquisition of features, i.e. be targets of phonological processes, while prespecified segments cannot, and hence show the relevant blocking effects. See Inkelas (1998) and references therein for full details.

The relevant Turkish data are shown in (12).

(12)	a.	bebek	‘baby’	b.	sokak	‘street’
		bebe-i	‘baby-ACC’		soka-ɨ	‘street-ACC’
		bebe-e	‘baby-DAT’			

In (12a) the suffixed forms of the accusative and dative both undergo /k/ deletion. Similarly, in the accusative form of (12b), stem-final /k/ also undergoes /k/ deletion, while stem-medial /k/ does not delete, because it does not occur at a morpheme juncture. An analysis that treated velar deletion as conditioned by an intervocalic environment would therefore not be able to capture this failure of /k/ deletion.

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Under Strict CV phonology, as can be seen in the structures in (13a), velar deletion takes place when the target is followed by an empty V position that signals the end of the stem that is affixed with the accusative or dative suffix.[10] In contrast to this, when a velar is followed by a filled V position, no deletion takes place (cf. medial /k/ in (13b)). Note that since deletion is only triggered by vowel-initial suffixes the precise triggering environment is an empty V+C sequence (underlined in (13)). In fact, this explains why the word-final velars in *bebek* and *sokak* in (12) do not get deleted; they are not followed by an empty V+C sequence.

(13) a. Velar deletion before an empty V+C sequence

```
C V C V C V-C V
| | | | |     |
b e b e k ∅ ∅ i
```

→ [bebei]

b. No deletion of medial velar

```
C V C V C V-C V
| | | | |     |
s o k a k ∅ ∅ ɨ
```

→ [sokaɨ]

A difference in the representation of phonologically vs. morphologically derived environment effects is that while the former is encoded by a structural difference in the melody, the latter is encoded in the constituent structure representation. I take both to be essentially the same, i.e. both involve a change in representation, even though this applies at different levels.

Further support for the Turkish analysis above is that the velar deletion rule does not apply to a suffix-initial velar, as the data in (14) show. This follows from the fact that these velars are not followed by an empty V+C sequence. In addition, consonant-initial suffixes do not trigger deletion of a stem-final velar, because the deletion configuration is not met in these cases either.[11]

(14) No velar deletion in suffix

a.	dört-gen	→ dortgen	‘quadrilateral’
b.	yedi-gen	→ yedigen	‘heptagon’
c.	ora-da-ki	→ oradaki	‘there-LOC-REL’

The structural configuration of a following empty V+C sequence can also be seen in the first velar palatalisation process discussed earlier for Polish, which is restricted to applying at morpheme boundaries. Recall that I-containing vowels in Polish trigger palatalisation of a preceding velar. Consider the additional data in (15), which show that first velar palatalisation does not occur in monomorphemic words.

(15) Restriction on first velar palatalisation

a.	[ke]lner	‘waiter’
b.	a[ge]nt	‘agent’
c.	[x’i][gi]enistka	‘hygienist

[10] Empty positions can only be licit in the CV structure if they are licensed. Filled positions rather than empty ones can act as licensers. See Scheer (2004) for full details.

[11] I thank a reviewer for pointing out the relevance of V- vs. C-initial suffixes to the Turkish facts.

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The forms in (15) do not palatalise, because they do not occur before an empty V+C sequence.

The empty C position is crucial to the analysis, as it helps us to capture morphological boundaries in synthetic morphology; the /i/ triggers of palatalisation are part of suffixes. By virtue of this, we do not predict palatalisation just in case a root-internal velar is followed by an alternating vowel in Polish, i.e. in a [C∅CV] configuration (where the initial C is a velar), given the presence of vowel–zero alternations in Polish.[12]

Another case where an empty V+C sequence plays a role is in Finnish assibilation (Kiparsky, 1973, 1993), where /t/ assibilates to /s/ before /i/, but only when /i/ is a suffix. Thus in (16) stem-initial /ti-/ in (16b) does not assibilate, while stem-final /ti-/ in (16a, b) does.

(16) Finnish /t/ → /s/ assibilation before an empty V position

a.	halut-a	'to want'	→	halus-i	'wanted'
b.	tilat-a	'to order'	→	tilas-i	'order-3SG PRET'

As in the structures in (13), the Finnish facts follow from the assumption that assibilation applies in (16) whenever an empty V+C sequence occurs after the target. The stem initial /ti-/ sequence, with no empty V+C sequence following /t/, does not show assibilation effects, but is rather a case of a derived environment effect.

So far we have seen that an empty V+C sequence can be used to capture morpheme boundaries within synthetic morphology, particularly for vowel-initial suffixes. The situation is slightly more complex for prefixes, as in the case of Chumash pre-coronal laminalisation, which we will characterise as being a morpheme-integrity effect. Pre-coronal laminalisation in Chumash, as documented in Applegate (1972), turns /s/ into /ʃ/ before another coronal but only when the intended target is morpheme final. Thus the data in (17a), with pre-coronal laminalisation, contrast with those in (17b), which do not exhibit the process.

(17) a. Pre-coronal laminalisation

s-lok'in	→	ʃlok'in	'he cuts it'
s-tepuʔ	→	ʃtepuʔ	'he gambles'
ka-s-tepet	→	kaʃtepet	'it rolls'

b. No pre-coronal laminalisation in monomorphemic words

stumukun	'mistletoe'
wastuʔ	'pleat'
slowʔ	'eagle'

Although a C-final prefix (as in (17a)) can be differentiated from a word-internal C-position with respect to the presence or absence of a following empty V-position, the situation in (17) is complicated by the fact that the relevant /s/ in both environments occurs after an empty position: a prefix-final empty V in (17a) and an empty V separating an S+C cluster in (17b). In addition, in languages with vowel–zero alternations, a C followed by an empty V may not easily be exclusively identified as a prefix boundary. One way of getting around this is to consider the prefix in (17a) to be analytic and therefore forming a phonological domain of its own, as opposed

[12] The analysis here is restricted to accounting for the environment of first velar palatalisation, while the phonological process of spreading of the I-element from the suffix to the target, as shown in section 3.1, is achieved at a different level. See Rowicka (1999) for an analysis of Polish vowel–zero alternations in Strict CV.

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to (17b), which are monomorphemic words consisting of a single phonological domain. In this way we would be able to capture the relevant context of laminalisation as following an empty V-position that is licensed by a V-position which resides outside its own domain.[13] Square brackets in (18) indicate phonological domains.

(18) a. Pre-coronal laminalisation

```
[C  V]- [C  V  C  V  C  V]
 |  |    |  |  |  |  |  |
 s  ∅    t  e  p  u  ʔ  ∅
```

b. No pre-coronal laminalisation

```
[C  V  C  V  C  V  C  V]
 |  |  |  |  |  |  |  |
 w  a  s  ∅  t  u  ʔ  ∅
```

Thus, while laminalisation occurs at the edge of a morpheme it is best analysed as a case of a morpheme-integrity effect, where the undergoer must form its own independent phonological domain, as in (18a), as opposed to (18b).

Morpheme-junctural effects can thus be uniformly accounted for as occurring in a context where the target of alternation is followed by an empty V+C sequence, for the cases discussed, or by an empty V, which denotes the relevant morpheme juncture, barring any other complications. Conversely, the absence of such empty V+C sequences or empty V positions in monomorphemic words accounts for derived environment effects.[14] Let us now consider a few cases where morpheme integrity, rather than morpheme boundaries, plays a role in determining where phonological processes apply.

4.2. Morpheme integrity effects

Apart from morphologically derived environment effects restricting phonological processes to applying only at morpheme junctures there is also another kind of derived environment effect that restricts particular phonological processes to applying either to the root or the affix. Consider in this respect the phonotactic requirement on Turkish derived words to be disyllabic, which some speakers display (Itô and Hankamer, 1989; Orgun, 1996). Thus while derived words such as (19a) are ungrammatical, the non-derived monosyllables in (19b) are acceptable. ((19a) can have alternative derived forms, as shown in brackets, which do not violate the derived word minimality.)

(19) a. Derived words: minimality
*fa-m ‘musical note *fa*-1SG POSS: my *fa*’ (sol-um ‘my note *sol*’)
*be-n ‘eat-pass.’ (yut-ul ‘be swallowed’)
b. Non-derived words: no minimality
fa ‘musical note *fa*’
ye ‘eat!’

[13] One would naturally like to assume that there are phonological processes that can act as tests to establish whether a prefix is synthetic or analytic. In case it is synthetic, i.e. allowing no internal phonological boundaries, then some formal way of differentiating affixal from non-affixal material will have to be developed so that a C-final prefix is identified as one involving non-affixal to affixal empty V-licensing. I do not pursue this issue here.

[14] Empty V-positions in TR (sonority-increasing) clusters can be excluded on grounds of their being licensed by an infrasegmental government relation. RT (sonority-decreasing) clusters would present the same problem as discussed above.

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This disparity between the phonology of roots and affixes is most insightfully treated in Government Phonology as a result of domain interaction in phonology–morphology relations. Kaye (1995) distinguishes synthetic from analytic morphology by regarding the former as involving one phonological domain, while the latter shows internal phonological domains. As pointed out in section 4.1, Kula (2002) builds on this work and treats the internal phonological domains in analytic morphology as being involved in head-dependent relations. The difference between the phonology of roots and affixes can in this respect be seen to follow from the internal phonological structure assumed in analytic morphology. Thus, we retain the general idea of capturing derived environment effects from structural differences between undergoers and non-undergoers.

The Turkish distribution in (19) can in this sense be regarded as a restriction on the size of the dependent affix domain, if it is present. The dependent must contain at least one syllable with a full vowel. An illustration is given in (20).

(20) Domain dependency

a. * $[\,[\text{fa}]_{H}\quad[\text{m}\varnothing]_{D}\,]$

b. $[\,[\text{sol}]_{H}\ [\varnothing\text{um}\varnothing]_{D}\,]$

c. [fa]

(20a) shows a dependent domain that has no full vowel and is hence ungrammatical. (20b) shows an acceptable dependent, and (20c) is a monomorphemic word that has no dependents and hence no environment for the minimality effect to apply on, resulting in a monosyllabic output. The fact that the two domains form independent phonological domains has some bearing on the requirement for at least one full vowel. Vowelless syllables are probably not good independent words in Turkish and therefore, despite empty nuclei being allowed in general within words and at the end of words, an independent domain must contain at least one realised vowel. This implies that if there are C-only affixes in Turkish they will be synthetic, a prediction which seems to be borne out.[15]

Such independent domain structures allow us to characterise both effects that apply only to roots and those that apply only to affixes by restricting the domain of application to the relevant domain. Basque /a/ to /e/ raising, which is blocked in roots and only applies in suffixes and clitics (Hualde, 1989), can in this respect be formulated as a phonological process that targets final vowels in dependent domains if the suffixes are treated as involving analytic morphology and therefore residing in phonological domains independent from the root. In the same vein, a number of processes in many Bantu languages are sensitive to a distinction between a head and dependent domain where heads acts as triggers and dependents are undergoers.

The ability to refer to independent phonological domains in morphologically complex forms allowed by morphology–phonology interactions in Government Phonology thus affords us analyses where reference may be made to either roots or affixes, as exemplified by the Turkish

[15] The prediction finds support in the distribution of affixes in Turkish where suffixes are seen to alternate between being vowel-initial or not, depending on whether the base ends in a consonant (the former applies) or ends in a vowel (the latter applies). Thus we have, for the 1st person singular *ev-im* ‘my house’ vs. *kuzu-m* ‘my lamb’. The *-k* of the 1st person plural, *-n* of the passive and *-t* of the causative behave in similar fashion (Monik Charette, personal communication). This provides support for treating a -C suffix as synthetic.

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word minimality and Basque raising facts. The structural difference between derived and non-derived environments advocated throughout this paper is in this case a manipulation of phonological domains in morphology.

5. Conclusion

Derived environment effects, where particular phonological processes are restricted to applying only in derived environments, have here been treated representationally as resulting from either melodic or constituent structural differences in both phonologically and morphologically derived environments. The former has been used to account for why, in the cases discussed, only derived segments are the targets of further rule application; unlike non-derived segments, they display the necessary configuration of elements, particularly, they involve branching dependents. The latter has been used to account for junctural effects as essentially involving single phonological domains in synthetic morphology, where an empty V+C sequence provides the context for phonological rule application. In addition, we have seen that morphologically complex words with internal phonological domains can be used to characterise phonological rule application restricted to either root/base or affix domains. I have offered a unified account of phonologically and morphologically derived environments only in as far as both make reference to a difference in representation between derived and non-derived environments. The analyses are not mutually interchangeable, however, exactly because they occur at different levels of representation; I remain sceptical of analyses that claim such a unified approach.

There are a number of issues that still need to be clarified with respect to the branching dependent position; e.g. are all other features in the branching dependent position more mobile than those in a dominance relation? Presumably tone, voice and nasality in the branching dependent position are more mobile, but it remains to be seen whether they are more likely to be delinked from this position than, say, spreading place features in an immediate dominance relation.

I leave detailed discussion of previous analyses and the assessment, both in terms of overlap and viability of approach, and whether parallel analyses to that proposed here may be developed for overapplication effects, to a future occasion.

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