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*Segmental complexity and phonological government**

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1 Introduction

In this article, I explore a class of phonological reduction phenomena which highlight the role of segmental complexity in phonological government. I discuss a condition on phonological representations which requires that a segment occupying a governed position be no more complex than its governor, where complexity is straightforwardly calculated in terms of the number of elements of which a segment is composed. More generally, the present enterprise is to be seen as part of a wider programme in which reduction phenomena, including those traditionally referred to as lenition, are examined for the light they shed on the internal structure of consonants.

The analysis to be presented here is guided by two main objectives. Firstly, in representational terms, all lenition phenomena are to be directly characterised as segmental decomposition, specifically as the loss of material from the internal structure of a segment. Secondly, a non-arbitrary connection is to be established between a reduction event and the context in which it occurs.

The first of these goals can only be met by a phonological theory in which phonological oppositions are expressed privatively. If we view segments as being composed of univalent atoms or elements, then any reduction process can in principle be simply expressed as the loss of one or more atom from the internal structure of a segment. One such theory of segmental structure, which I adopt here, is provided by Government Phonology (Kaye *et al.* (henceforth KLV) 1985, this volume).

One salient characteristic which sets Government Phonology apart from other current theories is the rejection of the orthodox rewrite rule, and with it the notion of rule ordering, as the correct way of formalising phonological processes. Instead, phonological events are conceived of as occurring freely in direct response to structural and segmental conditions which are locally present in the phonological representation. This results in an extremely impoverished theory of phonological activity. In fact, only two possible types of phonological operation are formally expressible: COMPOSITION, in which elements spread from one segment and fuse with elements contained in a neighbouring segment; and DECOMPOSITION, in which elements are lost from the internal representation of a segment. No provision is made for operations of substitution whereby an element in a particular context could be randomly replaced by any element not locally present in the string. There can thus be only one way of formally expressing lenition and related reduction events: in terms of segmental decomposition.

This issue bears on the second of the objectives alluded to above, namely the search for a non-arbitrary account of phonological events. An account of a particular phonological event can be said to be non-arbitrary to the extent that it establishes a logical connection between the event and the context in which it occurs. (On this point, see Kaye 1989: ch. 3.) One of the widely recognised flaws of *SPE*-type rule-based approaches is the inherent arbitrariness of the rewrite-rule formalism. Within this sort of framework, naturally occurring process types such as assimilation and lenition are no more highly valued in terms of the formalism than non-occurring types. One of the obvious successes of non-linear phonology has been to rectify this situation as it applies to assimilation. The mechanism of autosegmental spreading now provides a non-arbitrary treatment of assimilatory phenomena, in which a direct formal connection is established between an assimilating target and its conditioning trigger. So far, however, no parallel account of lenition processes has been forthcoming.

Under the analysis to be developed here, the logical contextual link in reduction processes derives from the governing relations which hold between particular positions within a phonological string. In particular, given the role of segmental complexity in phonological government, there is pressure on segments occupying governed positions to reduce their level of complexity *vis-à-vis* their governors.

The article is organised as follows. I begin in §2 by reviewing the salient characteristics of lenition which must eventually be accounted for by the theory. In §3, I demonstrate how a framework which incorporates univalent individually pronounceable elements is better equipped than orthodox feature-based approaches to represent reduction directly as the loss of segmental structure. I outline the theory of element structure that is part of Government Phonology and show how this allows us to calculate segmental complexity in a straightforward manner. In §4, I discuss the role of segmental complexity in phonological government and show how these concepts enable us to derive phonotactic sonority effects as well as the notion of preferred reduction site. According to the theory, government operates at three levels of phonological structure; I examine language data which illustrate segmental reduction effects at two of these levels and briefly indicate how parallel effects are observable at the third. §5 is devoted to a detailed analysis of a number of lenition processes which affect *t* in different varieties of English. In §6, I examine strengthening and conclude that processes of this sort typically fall into the class of assimilatory phenomena. §7 summarises the findings and suggests directions for future research.

2 Lenition

It is difficult to agree with Bauer (1988) that it is possible to provide a complete pretheoretical definition of lenition/weakening or its assumed opposite, fortition/strengthening. A glance at the literature on phonological 'strength' confirms that one researcher's lenition frequently turns out to be another's fortition. For example, both the affrication and the glottalling of plosives are treated as types of weakening by Lass & Anderson (1975) and as types of strengthening by Foley (1977).

Nevertheless, it is fair to say that there exists a core of phonological process types which would informally be classed as consonantal lenition by the majority of phonologists. This agreement presupposes prior acceptance of some notion of phonological strength *vs.* weakness, for which Vennemann provides the following working definition: 'a segment X is said to be weaker than segment Y if Y goes through an X stage on its way to zero' (quoted by Hyman 1975: 165). This is not meant to imply that lenition inexorably leads to eventual deletion in individual systems. Rather, it is a statement about recurrent patterns that become evident when we compare weakening processes across languages. In some cases, multiple stages in a given lenition sequence can only be identified through historical reconstruction. In others, two or more stages coexist within the same system either in the shape of productive alternations or in static distributional patterns.

Lenition processes typically manifest themselves in articulatory terms as a decrease in the degree of supraglottal stricture and in aerodynamic terms as a decrease in resistance to airflow through the vocal tract (Ní Chasaide 1989). These effects are most clearly seen in what Lass & Anderson (1975) refer to as 'opening' types of lenition. Instantiations of opening include spirantisation of plosives, vocalisation of consonants and debuccalisation (complete loss of supraglottal gesture).

In the following sections, I examine three aspects of lenition which up to now have resisted satisfactory treatment within phonological theory. The first concerns the search for a theory of segmental representation which will allow us to express segmental weakening in a direct manner (§§3.1–3.3). Related to this is the issue of how we might account for the observed tendency of lenition to follow certain preferred trajectories (§3.4). Thirdly, there is the question of why there exist phonological environments in which lenition is more favoured than others (§4).

3 Segmental structure

3.1 Feature-based analyses of segmental reduction

The phenomenon of segmental weakening is difficult to express in any direct and unified manner using traditional binary-valued feature formalism. Lenition processes can equally well involve shifts from plus to minus values as from minus to plus. One implication of vocalisation, for example, is a change in the specification of [consonantal] from plus to minus. Spirantisation, on the other hand, involves alteration of [continuant] from minus to plus. More seriously, some types of lenition simultaneously affect more than one feature, and the theory provides no single mechanism for directly linking just these features in preference to some other arbitrary conjunction.

To illustrate this point, let us consider the vocalisation of neutral (lax) *p* and *t* in Korean. Since my immediate concern is with the process itself rather than the context in which it takes place, it is sufficient for the time being to refer to the environment informally as intervocalic position. Later I will argue that the relevant conditions involve phonological government. Vocalisation in Korean produces alternations between neutral *p* and *w* and between neutral *t* and *r* (stops transcribed as follows: C^h = aspirated, C' = tense/glottalised, C = lax/neutral):[1]

(1)

INDICATIVE	STATIVE	
č^{h}up-t'a	č^{h}uw-ə	'to be cold'
ki:p-t'a	kiw-ə	'to sew'
ətup-t'a	ətuw-ə	'to be dark'
tə:p-t'a	təw-ə	'to be hot'
ku:p-t'a	kuw-ə	'to bake'
tɨt-t'a	tɨr-ə	'to hear'
mu:t-t'a	mur-ə	'to ask'
ilk^{h}ət-t'a	ilk^{h}ər-ə	'to name'
kə:t-t'a	kər-ə	'to walk'
si:t-t'a	sir-ə	'to load'

In *SPE* terms, this process might be expressed as the simultaneous rewriting of the values for [sonorant] and [consonantal]:

(2) $$\begin{bmatrix} -\text{son} \\ +\text{cons} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{son} \\ -\text{cons} \end{bmatrix} / \text{ V—V}$$

The accompanying change from [−continuant] to [+continuant] might be handled by redundancy rule. The rule is arbitrary to the extent that the combination of features and their values is no more highly valued than other formally expressible combinations of two features. Most of these other permutations express processes which are unattested in intervocalic (and in many cases any other) position.

There are at least two representational issues at stake here. More specifically, there is the question of how the relation between consonantal and vocalic features should be expressed in processes such as vocalisation. More generally, there is the problem of constraining the theory in such a way that the whole class of segmental reduction phenomena can be

directly expressed in phonological representations without resorting to arbitrary feature combinations.

Taking the more specific issue first, consider how the place feature values of the labial segment in *p*→*w* vocalisation are to be specified. This bears on the more general question of how the specification of glides should be related to that of contoids and vowels. There are various alternatives available within an orthodox feature framework. If separate cavity features are employed for vowels and consonants, a decision has to be made about which set is appropriate for glides. If glides are classified in the same way as vowels, then some provision will have to be made for translating the [+anterior, −coronal] specification of *p* into the [+round, +back, +high] specification of *w*. This would involve either extending the structural description of (2) or invoking supplementary redundancy rules. Once again the combinations of features and their values are more or less arbitrary. This problem obviously does not arise if glides are specified in terms of the same cavity features as consonants. This can be achieved by retaining dual sets of cavity features and stipulating that glides classify for the consonant set. However, vocalisation processes as well as processes involving place assimilation between contiguous vowels and consonants suggest that a more radical alternative is to be favoured: one in which the place-of-articulation dimensions of vowels and consonants are represented in terms of the same atoms. This is the tactic that has been explicitly adopted in a number of frameworks, including Dependency Phonology (Anderson & Jones 1974; Anderson & Ewen 1987), Government Phonology (KLV this volume) and the 'extended dependency' approach of van der Hulst (1989) and Smith (1988). It has also been pursued in more recent feature-geometry work (Clements 1989).

Let us turn now to the more general problem of representing segmental reduction. The idea that lenition processes should be directly expressed in terms of segmental decomposition is not new. Lass (1976) presents an analysis of debuccalisation in which consonantal features are organised into two independent gestural configurations, one laryngeal, the other supralaryngeal. This refinement of *SPE* representational structure clearly presages certain aspects of the feature geometry model (Clements 1985). According to Lass (1976: ch. 6), reduction to *h* or *ʔ* consists in the deletion of the supralaryngeal gesture. The notion of autonomous segmental gestures is strongly reminiscent of work within Dependency Phonology (see for example Durand's 1986 treatment of weakening to *h* or *ʔ*). However, unlike the latter theory, Lass's account incorporates orthodox binary features and thus retains some of the arbitrariness of standard *SPE* analyses alluded to above. (For example, vocalisation and spirantisation still involve arbitrary switches in feature values.)

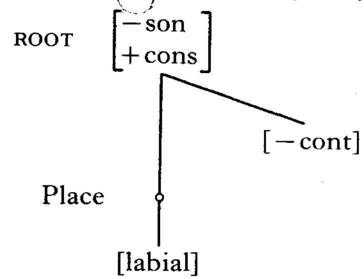
A unified decomposition analysis of lenition is more readily realised within a framework which expresses phonological oppositions privatively. Using univalent phonological atoms, as in Dependency Phonology, Government Phonology or Particle Phonology (Schane 1984), it is in principle possible to represent lenition directly as the loss of material from a segment's make-up.

This type of operation is in part also available in current versions of the feature-geometry model, at least to the extent that non-terminal nodes in the feature hierarchy express privative rather than binary oppositions (Clements 1985; Sagey 1986). In fact, segmental reduction processes have been cited as evidence supporting the existence of intermediate nodes such as Place and Laryngeal (Clements 1985; McCarthy 1988). McCarthy (1988) demonstrates how debuccalisation in, for example, *s*→*h* can be represented as a delinking of the Place node, which automatically entails a delinking of all the nodes dominated by Place, including in this case Coronal and [+anterior]. The residual Laryngeal node and its associated [+spread glottis] feature define the debuccalised segment as *h*. The same operation characterises the debuccalisation of glottalised *t*' to *ʔ*, in this case the remaining Laryngeal feature being [+constricted glottis].

McCarthy assumes that loss of the Place node under debuccalisation entails loss of the feature [continuant]. However, this connection is not easily captured explicitly within the feature-geometry framework. In McCarthy's revised geometric model, [continuant] is independent of Place by virtue of being directly dependent on the Root node. In principle, then, the feature should remain unaffected by any delinking of Place. McCarthy's response to this problem is to attribute the loss of manner distinctions in debuccalisation to independent properties of articulation. One formal means of ensuring that [continuant] and Place are delinked simultaneously is to make them both dependents of a Supralaryngeal node (as in Clements' 1985 version of the theory). However, McCarthy denies that there is sufficient motivation for an intermediate node of this type (a conclusion also reached by, among others, Iverson 1989 and Archangeli & Pulleyblank forthcoming). Another alternative is suggested by Browman & Goldstein (1989) in their model of gestural phonology. They propose that constriction degree, the gestural analogue of manner, is not represented as a single node in the feature tree but is rather viewed as a cross-classifying dimension which is directly specified in each articulator node. This solution has the advantage of ensuring that deletion of an articulatory gesture entails deletion of everything with which it is associated, including the location and degree of the constriction. However, it fails to handle spirantisation, another widespread type of lenition (as in *b*, *d*, *g*→*β*, *ð*, *γ*, on which more below), in which the constriction degree dimension shifts independently of constriction location. Moreover, if the notion of non-hierarchical cross-classifying gestures is carried over into the feature-geometric model, it subverts the main rationale behind the theory.

Let us now examine how vocalisation of the type that is illustrated by the Korean facts in (1) is represented in the feature-hierarchy model. Consider what modifications are necessary to turn the following representation of *p* (based on the feature hierarchy proposed by McCarthy 1988) into one corresponding to *w*:

(3)



(In this case, it is probably justifiable to leave the laryngeal node out of consideration. Given current assumptions regarding the underspecification of features, segments which lack an active laryngeal gesture (i.e. neutral obstruents such as those found in Korean and spontaneously voiced sonorants including *w*) are presumably unspecified for this node in underlying representation.) As above, some provision has to be made for the lip-rounding in *w*; this can presumably be supplied as a default value for [round], which in this model is directly dependent on the [labial] node. Otherwise, the following alterations are required:

(4) [−son] → [+son]
[+cons] → [−cons]
[−cont] → [+cont]

Two independent nodes are affected here: [continuant] and the Root node, in which, according to McCarthy (1988), the major-class features [sonorant] and [consonantal] are both directly lodged. As with the *SPE* formulation in (2), the problem is one of excessive arbitrariness. In this case, the hierarchical arrangement of features provides no motivation for why this particular set of features together with their particular coefficients should pattern together as opposed to any other formally expressible combination.

In the Government analysis to be developed below, I demonstrate how a theory in which segments are composed of uniformly univalent elements can express reduction processes directly in terms of the loss of material from the internal structure of segments. By identifying the correct elements and declaring them to be fully specified entities, we are able to derive the reduced outputs of weakening processes, such as glides and *h*, *ʔ*, the reduction segments *par excellence*, without recourse to overridable default rules. The guiding principle is that all and only the attested types of segmental reduction should be formally expressible without having to resort to arbitrary conjunctions of phonological atoms.

Before I present the details of this analysis, it is in order to provide a brief outline of the theory of segmental structure in terms of which it is expressed.

3.2 Internal composition of segments

The theory of segmental structure I am assuming here is based on that presented in KLV (1985) and further developed in KLV (this volume). The following salient aspects of the theory are relevant to the present discussion.

Phonological oppositions are expressed privatively in terms of univalent elements. Each element has an independent phonetic interpretation and consists of a number of attributes, one of which is marked or salient (what KLV 1985 refer to as its 'hot feature'), the others unmarked. It is a universal characteristic of elements that they are fully specified at all stages of derivation; there are thus no lexically underspecified values and no redundancy rules. The full phonetic value of an element is manifested when it occurs as the head of a simplex segment (that is, when it does not appear in combination with any other element). For example, the salient property of the element I° is front; its unmarked properties are the supraglottal place dimensions non-round, high, non-low and non-ATR and the manner dimension approximant. The independent phonetic interpretation of I° is thus [ɪ].

Other vocalic elements proposed in KLV (1985) are (together with their salient properties): A^+ (non-high), U° (labial), and $ɪ^+$ (ATR). Another is v°, the so-called 'cold vowel', which consists of nothing but unmarked attributes, including non-round, back and high.

Elements may combine to form compound segments. The results of such combinations are derived by means of fusion operations, each of which involves two elements, one defined as the head, the other as an operator. In an expression derived by means of fusion, the operator contributes only its salient property; all other properties are contributed by the head. For example, the operation which fuses I° as a head and A^+ as an operator results in a segment which is non-high (the salient property contributed by A^+), non-back, non-round, non-low, non-ATR and approximant (the unmarked attributes contributed by I°), i.e. [ɛ]. Since v° contains no salient property, it only ever manifests itself when it occurs as the head of an expression.

Each element resides on its own autosegmental line. Phonological representations are plotted on a two-dimensional grid which consists of a series of intersections of lines and segmental positions. Each intersection represents a binary choice: either the element identifying that particular line is present or it is absent.

A further property of elements, known as charm, has an impact on their combinability, on their organisation into segmental systems, and on the ability of segments to occupy particular positions in phonological strings. Each element is assigned one of three charm values: positive, negative or neutral (indicated by the superscripts $^+$, $^-$ and $^\circ$ respectively). The combinatorial restrictions imposed by charm can be summarised as follows: (positively or negatively) charmed elements with like values are repelled, whereas there is an attraction between elements of unlike charm (KLV 1985: 311). Thus the fact that both A^+ and the ATR element $ɪ^+$ are positively charmed means that they cannot fuse, which accounts for the absence of fully low ATR vowels in the world's languages. In general, the charm value of a fused expression is determined by the charm value of its head.

In KLV (this volume), some of the vocalic elements are extended to the characterisation of consonants. Thus, I° defines palatality, while U° defines roundness in vowels and labiality in consonants. The element v°, with its unmarked high and back attributes, contributes velarity when it occurs as the head of a compound consonant. The nasal element N^+ is present in nasal consonants as well as nasalised vowels.

In order to characterise the coronal and manner dimensions of consonants, KLV (this volume) introduce three additional elements: R°, ʔ° and h°. The acoustic and articulatory exponents of these elements are fully discussed by Lindsey & Harris (1990). In signal terms, the salient property of ʔ° is defined as an abrupt decrease in overall amplitude. In articulatory terms, this effect is achieved by a non-continuant gesture of the type that characterises oral and nasal stops and laterals. Independently, the element is interpreted as a glottal stop, since this is the only articulatory means of achieving an amplitude drop without introducing marked resonance characteristics into the signal. The salient property of R° is a second-formant transition which is characteristic of a coronal gesture. When not harnessed to any other marked component, the transition is rapid; in articulatory terms, this means that the independent interpretation of R° is a coronal tap. In compound structures, ʔ° indicates constriction at the place of articulation defined by one of the other constituent elements. For example, the fusion of R° and ʔ° produces the sustained vocal-tract closure that characterises a coronal non-continuant.

The salient property of h°, according to KLV (this volume), is continuant, which in *SPE* feature terms identifies the class of medial fricatives and approximants. Here I propose a revised definition of h°, one which restricts it to obstruents. Specifically, I assume that the salient property of this element manifests itself as a narrowed articulatory stricture which produces turbulent airflow and which is responsible for the presence of high-frequency aperiodic energy in the speech signal. In other words, h° contributes a noise component to the structure of an obstruent. This type of property, in as far as it is deemed phonologically significant, is usually only associated with fricatives and affricates. Aperiodic energy, in the form of a noise burst, also characterises the release phase of genuine plosives (as opposed to unreleased stops). However, this effect has generally not been considered distinctive for this class of segments within orthodox feature frameworks. However, I will argue, on the basis of lenition evidence to be reviewed below, that a noise component is indeed part of the phonological identity of released plosives.

Like ʔ°, the unmarked attribute of h° is an absence of any supralaryngeal gesture. Independently, it is thus interpreted as a glottal fricative. In a compound structure, a place-defining element will indicate the location of the noise-producing gesture. For example, the fusion of h° and U° yields a labial fricative.

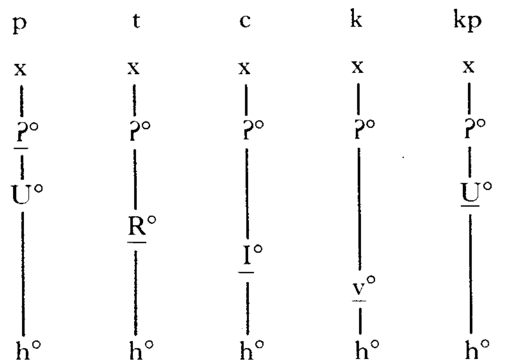
Two source elements are proposed by KLV (this volume): H^- and L^-, whose salient properties are respectively stiff vocal cords and slack vocal cords. When present in the structure of an obstruent, H^- indicates a fully voiceless or fortis consonant, while L^- indicates a fully voiced consonant. The representation of neutral obstruents, i.e. those which are articulated with no active laryngeal gesture, lacks any source element.

Below is a summary of the elements which are relevant to the discussion of consonantal lenition phenomena:

(5) *Salient properties of elements*

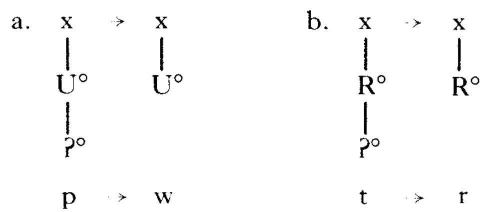
U°	labial	h°	noise
I°	palatal	N^+	nasal
v°	*none*	H^-	stiff vocal cords
R°	coronal	L^-	slack vocal cords
ʔ°	occluded		

The representations of neutral released plosives in (6) illustrate how elements combine to form compound structures (head elements underlined):[2]

(6)


3.3 Segmental complexity

We are now in a position to gain some preliminary idea of how Korean vocalisation is represented within an element-based framework. Let us begin by assuming that, in the leniting environment, neutral *p* and *t* are represented as in (7). The vocalisation process is expressed as the loss of ʔ°:

(7)


The simplex segment which represents the reduced output manifests the full phonetic identity of the remaining element. In the case of *p* → *w*, the residual element U°, which contributes only its salient labial property to the stop, defines a round high back approximant. In the case of *t* → *r*, we are left with a coronal tap.

We see now that, under an element-based analysis, lenition is defined quite simply as any process which involves a reduction in the complexity of a segment. Complexity is directly calculable in terms of the number of elements of which a segment is composed. In the Korean example (7), vocalisation is identifiable as a reduction process simply by observing that stops are more complex than glides, since the former contain at least one more element than the latter. (Later I will argue that true plosives actually have more elementary content than the stops shown in (7).)

The definition of lenition as element depletion unifies a range of process types which would not necessarily be related within other frameworks. For example, the so-called devoicing of word-final obstruents, which is sometimes treated as a type of fortition (e.g. Lass 1971), has more recently been analysed as the loss of a laryngeal element from a consonant's segmental structure (Brockhaus 1990). The reduction account appears to be more in tune with phonetic descriptions of the phenomenon (e.g. Ní Chasaide 1989). The raising of mid vowels has also been analysed as element loss, in this case A^+ (e.g. Harris 1990). Both of these phenomena count as reduction processes alongside processes for which the label lenition is more traditionally reserved. The fact that these reduction events typically occur in similar or identical contexts (to be discussed presently) suggests that this unification is not misguided.

3.4 Lenition trajectories

If the phenomenon of segmental reduction is difficult to express naturally within a feature-based framework, so is another recurrent characteristic of lenition, namely an observed tendency to follow preferred trajectories defined along the manner dimension.[3] Illustrations of the various preferences abound in the literature (see Lass 1984: ch. 8 for a summary). As indicated in §2, some of the examples are only identifiable as historical processes by means of well-established methods of comparative and internal reconstruction. Others are attested in individual languages as distributional effects or productive alternation patterns involving two or more stages on a given trajectory.

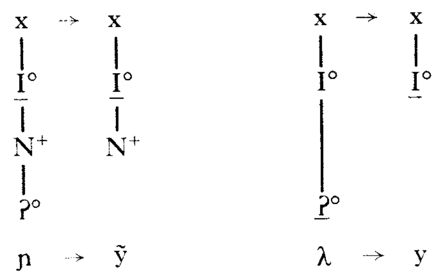
Starting with a plosive input, we can identify three typical developments. One, which I have already discussed in connection with Korean neutral stops, is vocalisation, characterised in (7) as de-occlusivisation, i.e. the loss of ʔ°. This analysis can be extended to the vocalisation of nasal stops and laterals, as could be illustrated by any number of languages. For example, in some types of southern Brazilian Portuguese, palatal ɲ and λ, which are non-continuants in most other dialects, are realised as ỹ and *y* respectively. The process is exemplified in

(8a) and represented in (8b) as ʔ°-loss.[4] Following KLV (this volume), I take laterals to be composed of two elements: a head ʔ° and an operator which identifies the place dimension (R° in the case of *l*, I° in the case of λ):

(8) a.

Northern	*Southern*		*Northern*	*Southern*	
baɲu	bãỹu	'bath'	veλa	veya	'old (f)'
soɲu	sõỹu	'dream'	paλa	paya	'straw'
viɲu	vĩỹu	'wine'	moλu	moyu	'sauce'

b.



The other two favoured lenition trajectories are also of the opening type. One route involves spirantisation (sometimes preceded by affrication, on which more below) and debuccalisation:

(9) *Opening I*
plosive → fricative → *h* → ø

An example of a system which has proceeded as far as spirantisation is provided by Liverpool vernacular English. In this dialect, as illustrated in (10a), *t* and *k* undergo spirantisation after stressed nuclei. The spirantised reflex of *t* is optionally realised as either a slit or a grooved alveolar fricative; in the latter case, neutralisation with *s* results. Word-finally in function words, lenition of *t* proceeds as far as [h], as in (10b):

(10) a.	[bɛs]	*bet*	[bɛ́sə]	*better*
	[bæx]	*back*	[béɪxə]	*baker*
b.	[æh]	*at*	[nɒh]	*not*
	[ðæh]	*that*	[bʊh]	*but*

Most types of Caribbean Spanish illustrate a pattern in which the last three stages of (9) survive as simultaneous reflexes of the same etymological category in the same system (in this case as sociolinguistic variants – see, for instance, Amastae 1989). Historical *s* is realised as *s*, *h* or zero in certain positions (exemplified by the emboldened *s*) in the following forms:

(11)	e**s**te	de**s**de	se**s**go	me**s**
	a**s**co	a**s**ma	a**s**no	habla**s**

The other type of opening development is glottalling, i.e. debuccalisation with no intervening spirantisation stage:

(12) *Opening II*
plosive → ʔ

One example is the process of Glottal Formation in Toba Batak discussed by Hayes (1986a). Others include the reduction of word-final plosives in Burmese. An older three-way *p–t–k* contrast, which is still reflected in Burmese orthography, has contracted to a two-way *t–k* pattern in northern dialects and has undergone wholesale merger under ʔ in standard dialects (data from Maran 1971):

(13)	*Northern*	*Standard*		*Northern*	*Standard*	
	tat	taʔ	'attach'	khuk	khouʔ	'chop, slash'
	tet	teʔ	'climb'	lik	leiʔ	'turtle'
	lit	liʔ	'abscond'	kyik	ceiʔ	'be hard'

Both types of opening, (9) and (12), show up in Malay as productive alternations. In the Johore dialect, velar plosives alternate with ʔ, while *s* alternates with *h* (data from Farid 1980):

(14) a.	masakan	'the cooking'	masaʔ	'to cook'
	sepakan	'the kick'	sepaʔ	'to kick'
b.	pəŋhabisan	'the end'	habeh	'finish'
	pəŋipasan	'the fanning of'	kipah	'fan'

(See Durand 1986 for a Dependency Phonology analysis of these patterns.)

The inability of feature-based approaches to capture the notion of preferred lenition trajectory has long been recognised. Various attempts at remedying this deficiency have involved the construction of strength hierarchies or scales which express implicational relations amongst segments, based on their participation in lenition or strengthening processes (e.g. Lass & Anderson 1975; Foley 1977). (For a summary and discussion of the relevant literature, see Harris 1985: ch. 2.) The hierarchy approach skirts around the major representational issue of how strength might be directly encoded in a segment's internal structure. As Lass & Anderson (1975) themselves concede, their scales are no more than taxonomic observation statements. In essence, the scales are independent look-up tables which reflect an acknowledgement that there is no direct way of expressing naturally occurring implicational processes within an orthodox feature framework. The same criticism can be levelled at attempts to characterise sonority relations in scalar terms.[5]

One major advantage that the element-based approach enjoys over feature-based accounts is that it allows for both reduction and sonority effects to be treated in a unified manner, namely in terms of segmental complexity. I will discuss the sonority dimension in more detail in §§4.4–4.5. For the time being, let us consider how the notion of segmental complexity outlined in §3.3 gives us a direct means of deriving the notion of preferred lenition trajectory. The present framework predicts an extremely restricted set of reduction events which, as far as I can tell, correspond to all and only the observed types. Recall that, within the Government framework, phonological events are restricted to the operations of composition or, as in this case, decomposition. There is no operation of substitution; that is, it is not possible to replace randomly a given element in the internal structure of a segment by any other element not already present in the representation. There is thus no formal means of expressing non-occurring processes of a sort that are quite easily accommodated within orthodox feature frameworks. For example, the spontaneous change *t* → *p*, which to the best of my knowledge is unattested in the 'classic' lenition context of intervocalic position, is straightforwardly represented as [+coronal] → [−coronal] but is ruled out in Government Phonology since it involves the unmotivated substitution of R° by U°.

If the analysis of reduction as element depletion is on the right lines, it follows that the set of lenition processes to which a segment is susceptible is logically limited by the number of elements of which the segment is composed. Moreover, lenition along a particular strength hierarchy should involve a progressive decrease in the elementary complexity of a segment. It then makes sense to suppose that the least complex segment, the one occupying the stage immediately prior to deletion, contains only one element. From the perspective of a framework in which phonological elements are held to have independent phonetic interpretation, this observation is highly significant: pre-deletion stages in lenition chains allow us actually to 'hear' individual elements. The foregoing summary of lenition trajectories identifies the following as 'primitive' segments which show up as pre-deletion targets: *ʔ*, *h* (both resulting from debuccalisation) and *w*, *y*, *r*, *ɰ* (all the result of vocalisation). Given the line of argumentation being employed here, each of these should be the autonomous phonetic instantiation of a particular element. And indeed, three of these segments are independently motivated as the manifestation of elements in vocalic systems, namely *w*/*u* = U°, *y*/*i* = I° and *ɰ*/*ɨ* = v° (see KLV 1985 and §3.2). The primitive status of *r*, *ʔ*, *h* in lenition processes provides support for the recognition of R°, ʔ° and h° as consonantal elements.

Let us pursue the notion of lenition as progressive decomplexification a little further by considering the various stages on the Opening I trajectory (9). If *h* is the least complex segment, the plosive input must be the most complex; oral fricatives are then of intermediate complexity. We can assume that an oral fricative differs from *h* by one degree of complexity: the former contains a place-defining element that is absent from the latter. By the same token, the internal structure of a plosive includes whatever material is present in a homorganic fricative but is more complex than the latter by virtue of an additional element, namely ʔ°. This line of reasoning leads us to conclude that h° must be present in all released obstruents, both plosives and fricatives. Opening I (9), as illustrated by the English, Spanish, Burmese and Malay facts in (10), (11), (13) and (14b), thus

involves the following representational stages (where coronal can be taken as representative of all place categories):

(15)							
x	→	x	→	x	→	(x)
|		|		|		
R°		R°		|		
|		|		|		
h°		h°		h°		
|						
ʔ°						
t	→	s	→	h	→	ø

As indicated in §3.2, the presence of h° in a plosive manifests itself as noise release. The analysis of spirantisation being proposed here is thus very much in the spirit of Lass & Anderson's (1975: 154) treatment of the phenomenon. They characterise spirantisation as the extension of a fricative release phase back into the closure phase of a plosive.

The other attested types of lenition are straightforwardly represented within this model. Consider the set of reduction events that can potentially affect a generic labial plosive composed of the elements ʔ°, U° and h°. Vocalisation to *w* is represented as the loss of ʔ° and h°. Opening II (12) corresponds to a loss of h° and U°. Two other lenition processes are predicted to affect plosives: loss of the place element alone and loss of h° alone. The first of these presupposes a potential contrast between glottal stops with and without noise release. Just this type of distinction is reported for Burmese by Cornyn (1964). However, given the present limited state of our knowledge of this phenomenon, it is not possible at this point to assess fully the validity of this particular prediction.

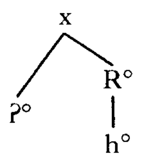
Absence of h° from the internal structure of an oral stop implies a lack of audible noise release. This corresponds to an unreleased stop of the sort that frequently appears in lenition-favouring environments. Languages which exhibit this type of consonant in word-final position include Thai and Vietnamese. One English example, which I will discuss in more detail below (§5), involves the unreleased (and preglottalised) *t* that shows up morpheme-finally in other than prevocalic position (e.g. in *get lost*) in accents which have tapped reflexes in certain other positions.

To sum up: the recurrent patterns of opening shown in (9) and (12) are expressible in terms of the relative complexity of the different segment types. Movement along an opening trajectory is straightforwardly definable as the progressive loss of elements from a segment's make-up.

Note that, under this account, it is only an overall reduction in segmental complexity which identifies particular processes as lenition. There is no inherent prediction regarding *which* elements will be lost. This is the result we want anyway, since languages vary freely in this respect. The point will be clearly demonstrated in the analysis of English *t*-lenition to be presented in §5. Of the different forms that this process takes in different dialects, I will focus on three, each of which results from the loss of one or more elements from the internal structure of *t* in certain positions.

Before concluding this section, let me briefly say something about affrication, a process that is sometimes attested as an intermediate stage immediately prior to spirantisation (as in the High German Consonant Shift). In line with current thinking, I assume that affricates have the same kind of contour structure as prenasalised stops, light diphthongs and rising or falling tones. That is, they consist of two segmental matrices associated to a single skeletal point. The affricate *ts* is represented as follows:

(16)



In representational terms, affrication involves decomposition without element loss, a process which, to bend further a traditional metaphor, I will refer to as BREAKING. That is, it results in the dissolution of existing elements into a contour structure.

4 Reduction sites

4.1 Lenition environments

It is well known that there is a tendency for certain phonological contexts to favour the operation of lenition more than others. By the same token, there are contexts which appear to protect segments from weakening and some which promote strengthening. For example, intervocalic position is frequently cited as the lenition context *par excellence* for consonants. The main issue at stake here is almost identical to that arising from the examination of preferences in lenition trajectories: it would be desirable if the positional propensities could be made to fall out from some aspect of the phonological representation.

The strength hierarchy model has been extended to deal with this phenomenon (Lass & Anderson 1975; Escure 1977). Under this type of analysis, any weakening which affects a given context on a positional strength hierarchy is predicted also to affect any context ranked lower on the hierarchy. This approach is susceptible to the same criticism as was levelled in §3.4 at segmental strength hierarchies: while it may achieve observational adequacy, it fails to code the observed preferences directly in phonological representations.

Government Phonology makes a number of precise predictions regarding the kinds of context in which reduction phenomena are to be expected. These predictions derive from the nature of the governing relations that hold between positions in a phonological string. Of central

importance in this connection is the role of segmental complexity in phonological government. The proposal I will develop here is that the complexity of a segment, as measured in terms of the number of elements of which it is composed, is directly related to its ability to occupy a governing position. In particular, a governed segment should never be more complex than its governor. The analysis of positional preferences in lenition is based on the claim that, wherever a segment occupies a governed position or a position intervening within a governing domain, there will be pressure on it to reduce its level of complexity. Before I develop this idea in more detail, it is in order to summarise the main outlines of phonological government.

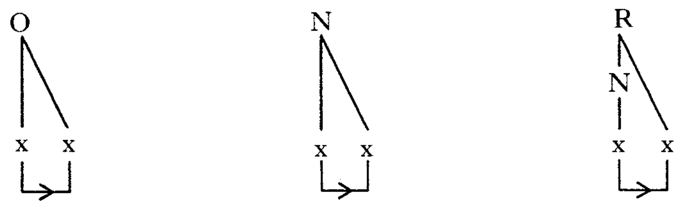
4.2 Governing relations in phonology

The following outline of phonological government summarises the detailed presentations of the theory that can be found in KLV (this volume) and Charette (in press).

Phonological government is an asymmetric relation holding between adjacent positions within a phonological string. Governing relations are established at three levels of structure: within syllabic constituents (constituent government), between constituents (interconstituent government), and between the nuclear heads of constituents (government at the level of nuclear projection). At the levels of constituent and interconstituent government, governing relations are universally defined as being strictly local and strictly directional, head-initial in the former case, head-final in the latter.

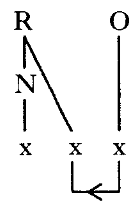
The theory recognises only three constituents: onset (O), nucleus (N) and rhyme (R). The conditions of strict locality and head-initial directionality permit the following maximal constituent structures (where the arrow indicates direction of government):

(17)

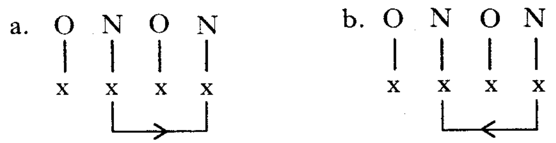


At the level of interconstituent government, strict locality and right-headed directionality define the following relation between an onset position and an immediately preceding rhymal complement:

(18)



Government at the level of nuclear projection is local, although not strictly local. In other words, nuclei entering into this type of relation are adjacent on their projection, even though the positions at lower levels of structure which they dominate are not necessarily adjacent. Directionality at this level of government is parametrically variable and is reflected in such prosodic phenomena as tone, stress, harmony and syncope. The following configurations illustrate respectively left and right-headed government at the level of nuclear projection:

(19) 

I conclude this brief overview of phonological government by mentioning two principles which will figure in the analyses that follow: the Projection Principle and the 'Coda' Licensing Principle.

The phonological implementation of the Projection Principle is defined as in (20) (KLV this volume):

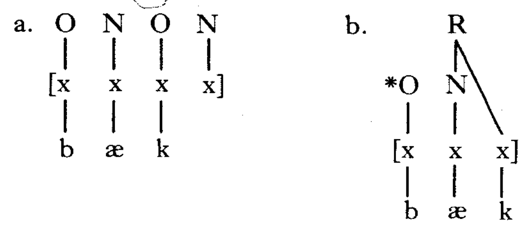
(20) *Projection Principle*
Governing relations are defined at the level of lexical representation and remain constant throughout a phonological derivation

The principle has two effects: during the course of a derivation, existing relations cannot be altered and no new relations can be created. One corollary is that resyllabification is not countenanced by the theory.

The 'coda' in Coda Licensing is an informal term referring to a rhymal complement position. (Recall that coda does not feature among the syllabic constituents recognised by the theory.) The principle is defined as follows (Kaye this volume; Charette in press):

(21) *'Coda' Licensing*
A post-nuclear rhymal position must be licensed by a following onset

One effect of this principle is to ensure that intervocalic consonants are universally syllabified within an onset and not in a preceding rhymal position, e.g. *ci.ty* and not **cit.y*. Another function of the principle is to account for the behaviour of domain-final positions which in other approaches are analysed as being extrametrical. It ensures that a word-final consonant occurs within an onset followed by an empty nucleus, as in (22a). The structure in (22b) is illicit because the position occupied by *k* is not licensed by a following onset:

(22) 

As Kaye (this volume) points out, one justification of the 'Coda' Licensing Principle is that it enables us to identify two autonomous dimensions which distinguish among syllabification systems: (a) whether or not the language permits closed syllables, and (b) whether or not the language permits domain-final consonants. In Government Phonology, these dimensions are expressed in terms of the following parameters: (a) branching rhymes (*yes/no*) and (b) empty nuclei licensed domain-finally (*yes/no*). The four possible types of syllabification system defined by the intersection of these parameters are all attested, e.g. Hawaiian (*no* and *no* respectively), Gur languages (*no* and *yes*), Japanese (*yes* and *no*), English (*yes* and *yes*). In a theory which recognises only the single parameter of open *vs.* closed syllables, it is a mystery why some so-called CVC languages only permit non-final closed syllables (the Japanese pattern) and why some otherwise 'CV' languages permit word-final consonants (the Gur pattern).

From the immediate perspective of the present study, a further advantage of 'Coda' Licensing is that it allows us to unify an apparently disparate class of contexts which favour segmental reduction. It is to this issue that we now turn.

4.3 The Complexity Condition

In KLV (this volume), it is claimed that the primary determinant of a segment's ability to occur in particular positions of government is its charm value. The authors propose that (a) (positively or negatively) charmed segments may occupy governing but not governed positions and (b) charmless (neutrally charmed) segments may occupy governed positions. However, they acknowledge that these charm requirements fail to take account of a class of relations in which a charmless segment governs another charmless segment. For this reason, KLV suggest that an additional determinant of governing capacity is a segment's complexity. In particular, they propose that a governing relation may hold between positions, both of which are occupied by charmless segments, provided that the governor is more complex than its governee.

Here I will try to motivate a reformulation of the complexity requirement which strengthens KLV's proposal in one respect and weakens it in another. Firstly, I suggest that the requirement be extended to all segments, irrespective of their charm values. In other words, any segment, be it charmless or charmed, must satisfy certain complexity requirements before it can occupy a governing position. Notice that this move does not affect the proposal that positively and negatively charmed segments are restricted to nuclear governing positions and non-nuclear governing positions respectively. Secondly, there is evidence, to be discussed more fully below, that the complexity requirement needs to be relaxed in certain circumstances to allow for a governee to have a complexity profile equal to that of its governor. The evidence suggests that the minimum steepness of the complexity slope within a governing domain varies according to the type of government involved.

In the light of this variability and as an initial formulation, I propose the following Complexity Condition, which allows for either a sloping or a level complexity differential between a governor and its governee:

(23) *Complexity Condition*
Let α and β be segments occupying the positions A and B respectively. Then, if A governs B, β must be no more complex than α.

The complexity value of a segment is simply calculated by determining the number of elements of which it is composed. According to (23), the bottom line is that a governee may never be more complex than its governor.

Before I discuss the implications of (23) in more detail, we can gain some preliminary idea of its effect by briefly considering examples of how it operates at each of the three levels of government. The first example involves branching onsets; here a downward complexity slope between a governor and its governee is universally enforced. This determines that *pl*, *tr*, *fl*, for instance, are possible intraconstituent clusters, whereas *lp*, *rt*, *lf* are not. The other two examples are cited by KLV (this volume) as cases where segmental complexity plays a role in conferring governing status on a neutrally charmed segment. One involves the sort of distributional asymmetries that are encountered in interconstituent sequences where, for example, a liquid can precede a nasal but not follow one. The ability of the nasal to govern the liquid (recall that interconstituent government is from right to left) cannot be due to charm values, since both types of segment are neutrally charmed. The asymmetry here follows from the Complexity Condition: nasals, which contain three elements, are more complex than liquids, which contain two and sometimes only one element. Other examples involve instances of proper government, where an empty nuclear position is governed by an adjacent nucleus which has phonetic content (see Kaye 1990; Charette in press). Any segment, charmed or charmless, is potentially capable of occupying a position which governs an empty position, given that the latter has zero complexity.

Given the role of segmental complexity in phonological government, we may identify particular environments where reduction activity is especially likely to manifest itself. The obvious place to start looking is in contexts containing directly governed positions. Here I will examine evidence of

reduction effects in governed positions at each of two levels of government: constituent (§4.4) and interconstituent (§4.5). Elsewhere, I discuss reduction effects in governed positions at the level of nuclear projection (Harris 1990).

4.4 Intraconstituent complexity effects

In the case of constituent government, reduction effects are only ever of a static distributional type. That is, at this level, we do not find any kind of alternation processes, let alone particular types which involve lenition. This observation follows from the Projection Principle, in line with which there is no operation akin to resyllabification whereby underlyingly heterosyllabic clusters become tautosyllabic and feed alternation processes during the course of a derivation.

The dimension of sonority is widely invoked as a determining factor in the severe cooccurrence restrictions that are observed to apply within syllabic constituents, particularly within onsets. Generally speaking, the dimension has been treated as a cover-feature (Vennemann & Ladefoged 1973) which is not directly coded in phonological representations. Its derivative status is reflected in the widespread practice of expressing sonority relations in terms of an independent hierarchy, on which ranks are specified in terms of feature combinations (e.g. Vennemann 1972; Hooper 1976: chs. 10–11). More recently, there has been a move towards characterising sonority effects in such a way that they can be read off phonological representations in a rather less indirect manner, for example by replacing the major class features by a multivalued sonority feature (Selkirk 1984), or by calculating the sonority profile of a segment on the basis of the amount of geometric structure (e.g. Rice 1990) or the number of plus-valued features (e.g. Clements 1989) it possesses.

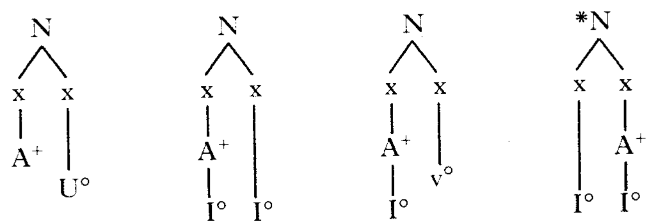
Selkirk's (1984) proposal is that segments are specified for a single *n*-ary sonority feature, where the value of *n* is assigned according to a segment's rank on the sonority hierarchy. Any set of segments with consecutive sonority values within designated limits supposedly constitutes a natural phonotactic class. Unfortunately, the ordinal arrangement allows for the capturing of quite unnatural classes, such as the set of non-low vowels, liquids, nasals and *s*.

Rice (1990) exploits the formalisms of feature geometry and underspecification to suggest that the sonority profile of a segment is identifiable on the basis of the amount of geometric structure it has. This account rests on the assumption that obstruents are less marked and therefore more underspecified than sonorants. Specifically, the more geometric structure a segment has, the more sonorous it is. Note that this generalisation only holds at the level of lexical representation; structural complexity differences begin to disappear as soon as redundancy rules fill in unspecified nodes and features. Given the privative nature of non-terminal nodes in feature hierarchies, Rice's approach is more directly comparable to the element-based approach being developed here than any of the others just mentioned. There is, however, one obvious difference: under Rice's account, relative sonority increases in direct proportion to structural complexity, whereas in the element-based model sonority increases in inverse proportion to segmental complexity.

There are at least two advantages that an element-based approach to sonority enjoys over feature-geometric accounts. Firstly, elementary complexity relations are identifiable at all levels of representation, both lexical and derived. This follows from the fact that elements are no less phonetically interpretable in underlying structure than they are in surface structure; recall that the theory lacks anything equivalent to underspecification and the filling in of redundant values. Secondly, the notion of elementary complexity provides a direct means of unifying sonority and lenition effects. There is nothing new in observing that sonority and strength are related. In fact, some scalar models of sonority have been described in terms of strength (e.g. Foley 1977), even though it must be emphasised that lenition trajectories do not uniformly coincide with the sonority hierarchy. (For example, vocalisation of oral stops does not pass through a nasal stage, despite the fact that nasals are intermediate between oral stops and glides on the sonority hierarchy.) From the viewpoint of the element-based model, sonority effects are simply the distributional analogue of reduction processes. In particular, the sonority relation between a pair of segments takes the form of a complexity slope between contiguous phonological positions, where the direction of the slope is determined by the direction of government.

Within syllabic constituents (which, recall, are universally left-headed), there is a severe limit placed on the complexity of a segment occupying the governed position in a branching structure. In branching nuclei, the governee can only ever be simplex; thus, the offset of a heavy diphthong governee can only ever be U° (as in (24a)), or I° (as in (24b)), or v° (as in (24c), where the offglide is frequently transcribed as 'ə'):

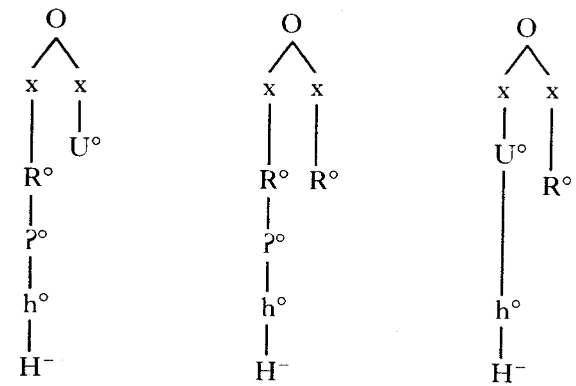
(24) a. au b. ei c. ei d. *ie



The governed position can never be occupied by a complex segment, for example, a mid vocoid composed of I° and A⁺, as in (24d). (Nor can it be occupied by a simplex segment composed of A⁺, by virtue of the latter's positive charm.) Any vocalic sequence which fails to satisfy charm or complexity requirements is predicted not to form a heavy diphthong. For example, *ie* might represent an onset–nucleus sequence, or a sequence of two nuclei, or a light diphthong (a contour segment associated with one nuclear point).

As illustrated in (24a), the governing position in a heavy diphthong may itself be simplex, which indicates that a zero complexity differential is tolerated in branching nuclei. This is not true of branching onsets, in which a downward complexity slope between the governor and its governee is universally enforced (downward, that is, when viewed from the perspective of the governor on the left). Thus, the first position is always occupied by an obstruent, which contains at least three elements; the governed position, on the other hand, is always occupied by a sonorant of some kind containing at most two elements.[6] The following examples illustrate the governance of a glide or liquid by a plosive or a fricative:

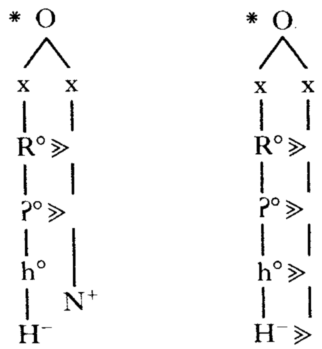
(25) a. tw b. dr c. fr



The task of establishing a universal complexity slope for onsets is complicated by the fact that the place dimension of consonants also plays a role in determining well-formed clusters. One thing is certain: the governed position within an onset can never contain more than two elements. (*l*, containing two elements, is apparently the most complex segment to occur here.) Nasal sonorants contain three elements and are barred from appearing in this position. That this restriction is not derivable solely on the basis of the Complexity Condition is demonstrated by the fact that the cluster *tn* is ill-formed as an onset, even though it displays the requisite complexity slope. Some additional dimension must be involved in the restriction, and the most obvious candidate is place.

There appears to be a strict limit on the amount of segmental material that can be shared by segments within a branching onset. For example, complete identity is ruled out; hence the universal absence of onset geminates. Nor can *l* be governed by a coronal plosive; any tautosyllabic *tl* or *dl* sequence must form a contour (lateral affricate) segment. Rice (1990) characterises this kind of restriction as a binding constraint on contiguous positions (specifically, a constraint on the amount of feature-geometric structure for which two positions can be bound). Reinterpreting this notion in terms of element theory, we can unify these phonotactic restrictions by stating that segments within a branching onset can be bound for at most one element. Thus *pr* is a well-formed onset (since the segments have no element in common), as is *dr* (since the two positions are bound only for R°, as in (25b)). On the other hand, the following sequences are ruled out as branching onsets on the grounds that the adjacent positions are bound for two or more elements: *tn* (two elements, (26a)) and *tt* (complete identity, (26b)):

(26) a. tn b. tt



As illustrated in (26), I assume that the sharing of segmental material between adjacent positions is universally represented as the spreading of elements from governing into governed positions.

Summarising the well-formedness constraints on onset clusters, we may say that a downward complexity slope is universally enforced between a governor and its governee. Other cooccurrence restrictions within this constituent are due to independent incompatibility constraints relating to place. In particular, onset segments which are bound for place may not be bound for any other element. As it stands, this last statement is no more than an arbitrary stipulation. Eventually, the state of affairs it describes should be derivable from some more general principle.

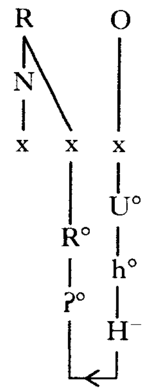
4.5 Reduction under interconstituent government

Transsyllabic clusters are also widely observed to be subject to severe cooccurrence constraints. As with the restricted onset phonotactics discussed in the last section, these have also frequently been interpreted in terms of sonority relations (see the references in §4.4 and the syllable contact laws outlined by Vennemann 1988). In this section, I will discuss how the Complexity Condition correctly predicts the type of distributional (§4.5.1) and alternation (§4.5.2) effects that manifest themselves in transsyllabic clusters.

4.5.1 *Distributional effects.* Recall from §4.2 that transsyllabic clusters involve an interconstituent governing relation, specifically one holding

between an onset and a preceding rhymal complement. Since directionality at this level of government (right to left) is the opposite of that in constituent government, we expect to find complexity slopes that are roughly the inverse of those evident within onsets. That is, the Complexity Condition predicts the existence of upward complexity slopes (viewed from left to right) such as the *-lf-* cluster in a form such as *dolphin*:

(27) -lf-



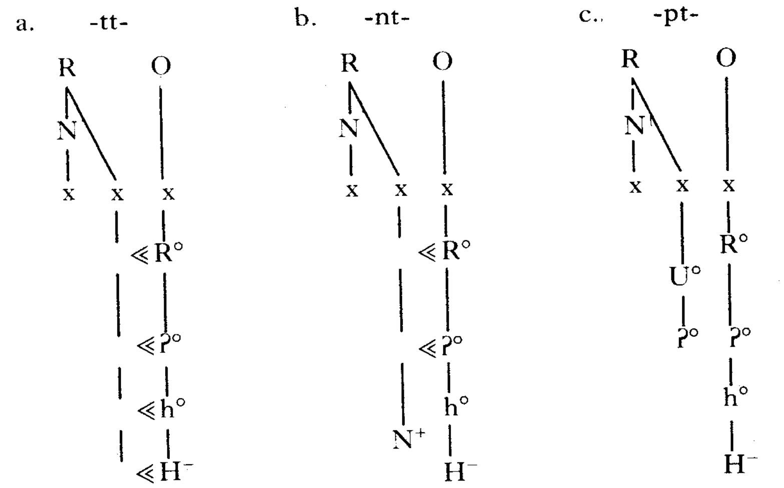
Genuine transsyllabic sequences with a downward complexity slope are predicted by the Complexity Condition (23) not to occur.[7] Beyond this, the problem of ascertaining the universal minimum complexity difference between a governor and its governee at the level of interconstituent government involves, as in the case of onsets, taking account of supplementary restrictions relating to the amount of segmental structure that may be shared by positions within a governing domain.

Within an interconstituent governing domain, the extent to which segmental material may be distinctively associated with the governed 'coda' position varies from language to language. In a language such as English, the inventory of possible segment-types occurring in this position is fairly unrestricted, at least from a comparative point of view. Thus we find, for example, 'coda' obstruents that are independently specified for place, *e.g. -pt-*, *-kt-* (as in *chapter*, *apt*, *doctor*, *act*) and *-ft-*, *-sp-* (as in *after*, *left*, *whisper*, *wasp*). The place specification of 'coda' nasals, on the other hand, is tied to that of a following onset consonant (within the same morphological domain), as in *pump*, *tent*, *think*. However, in some systems, the so-called 'Prince languages' (Prince 1984; Goldsmith 1989), we find a much more restricted pattern in which any 'coda' consonant must share place and constriction specifications with a following onset. Interconstituent sequences in such systems are thus restricted to geminates and/or homorganic nasal–consonant clusters. In the literature, this type of phonotactic constraint has been expressed in terms of feature licensing (Itô 1986; Goldsmith 1989). Within this framework, codas in a

Prince language only license the feature [nasal]; all other features which associate to the coda are licensed by the following onset.

Reinterpreting these facts in Government terms, we can conclude that an upward complexity slope is universally required at the level of interconstituent government. This is most obvious in the instance of Prince languages. The extreme case is that of geminates, illustrated in (28a), in which the entire segmental content is distinctively associated with the governing onset position, while the governed rhymal position is of zero complexity. In homorganic nasal–obstruent clusters (as in (28b)), the governed position contains only one element, namely N^+, while the place and constriction elements have their source in the governing position:

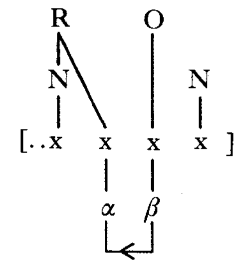
(28)



Where distinctively specified obstruents are permitted in governed rhymal positions, as in English, the transconstituent complexity slope is shallower but is still upward, as illustrated in (27) and (28c). The governed *p* in (28c) is lexically specified for U° (*-pt-* is distinct from *-kt-*) and ʔ° (*-pt-* is distinct from *-ft-*). However, it lacks a distinctive laryngeal element (the 'voicing assimilation' effect) as well as h° (hence its realisation as an unreleased stop) and is thus less complex than the following governing *t* to the tune of two elements.

4.5.2 *Interconstituent reduction processes: Arbore.* Let us now examine the role played by the Complexity Condition in inducing reduction alternations under interconstituent government. By way of illustration, we will consider a number of lenition processes in Arbore, an eastern Cushitic language spoken in Ethiopia (all data due to Hayward 1984). All of these processes take place stem-finally before a consonant-initial suffix. Nominal and verbal affixation in Arbore displays a high degree of morphological conditioning and lexical selectivity, which indicates that the suffixed forms we are dealing with have non-analytic structure. This is significant from the viewpoint of the present discussion, since it implies that a suffix-initial consonant (β in (29)) directly abuts on a stem-final consonant (α in (29)):

(29)



That is, there is no intervening empty nucleus which, under 'Coda' Licensing, would have been present had the stem constituted a cyclic domain.

In Arbore, context (29) presents the possibility of complexity deficits, specifically whenever a consonant occupying the governing suffix-initial position is lexically less complex than a governed stem-final consonant. In fact, potential complexity violations are resolved through the operation of various reduction processes. One of these involves the total regressive assimilation of stem-final non-glottalised stops to a following suffix consonant. In the same context, we find glottalised stops being reduced to ʔ, as evidenced in the following verbal (30a) and nominal (30b) paradigms:[8]

(30) a. *Perfect affirmative*

1sg: ʔíN...	2sg: ʔí...	1pl: ʔína...	
ɲaab'e	ɲaaʔte	ɲáaʔne	'fight'
simb'e	simiʔte	símiʔne	'sweat'
tuld'e	tuliʔte	túliʔne	'be sick'
ŋod'e	ŋoʔte	ŋóʔne	'pinch'
gaad'e	gaaʔte	gáaʔne	'bury'
hid'e	hiʔte	híʔne	'gird on'
hiik'e	hiiʔte	híiʔne	'grind'
halk'e	halaʔte	hálaʔne	'be hungry'
d'iik'e	d'iiʔte	d'íiʔne	'bleed'

b.

ɲalúb' (ur)	ɲaluʔmé (mr)	'afterbirth'
bómb'é (mr)	bómʔlo (dd)	'pond'
ǰéd' (bf)	ǰéʔlo (dd)	'scorpion'
d'ossók' (ur)	d'ossoʔmé (mr)	'blister'
huzzuk'anté (sr)	húzzuʔló (dd)	'start'
beek'ó (mr)	beeʔtáw (1sp)	'wound'
d'íik' (bf)	d'íiʔlo (dd)	'blood'
néek' (bf)	neeʔté (f, a)	'lion'

(*Abbreviations*: a = absolutive; bf = base form; dd = deictic definitive; f = feminine; mr = multiple reference; 1sp = 1st singular possessive definitive; sr = singulative reference; ur = unit reference)

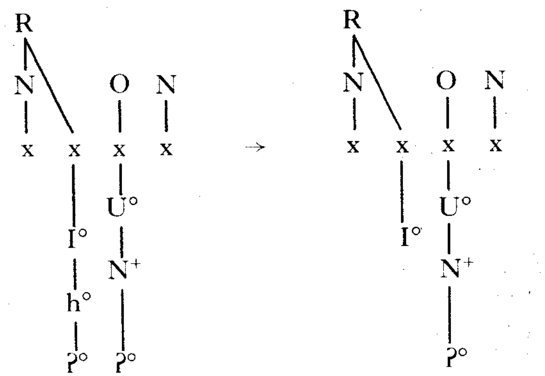
A full discussion of how element theory handles the representation of glottalised consonants would take us beyond the immediate concerns of the present study. I will simply assume here without further comment that consonants produced with glottalic release are represented as contour segments consisting of a complex portion in which the relevant place and manner elements are fused followed by a simplex portion containing ʔ°. Reduction of glottalised stops in Arbore then consists in the loss of the segmental material contained in the first portion of the contour structure, leaving only the ʔ° of the original release portion.

In the case of stem-final *č* and *č̓*, reduction leaves the palatal component intact. With non-glottalised *č* we get vocalisation to *y* (31a), while the reduced form of *č̓* is a postglottalised palatal glide (31b):

(31)	a.	ʔeruč (bf)	ʔeruymé (mr)	'vomit'
		hurd'ač (bf)	hurdaymé (mr)	'sling'
		gerrač (bf)	gerraymé (mr)	'thief'
		sermač (bf)	sermayté (f)	'kudu'
		hiyyač (bf)	hiyyayté (f)	'pauper'
		warač (bf)	warayté (f)	'hyena'
	b.	ŋooč'ó (mr)	ŋooyʔtásso (dd)	'barren cow'
		ʔač'éč'ó (mr)	ʔač'éyʔlo (dd)	'jaw'
		ʔíl leč'e		'I licked'
		ʔíy leyʔte		'she licked'

Under the assumption that a palatal stop is composed of ʔ°, h° and I° (as in (6)), the lenition here can be straightforwardly represented as the loss of ʔ° and h°. The effect is to steepen the complexity slope between the segment occupying the governing position and the governed stem-final consonant, e.g. *-čm-* → *-ym-*:

(32)



4.6 Reduction under nuclear government

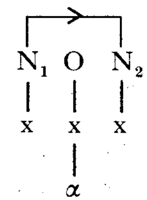
At the level of nuclear projection, the most obvious site to start looking for decomposition phenomena is in governed nuclear positions. Familiar

processes of this type include vowel syncope and vowel reduction under weak stress. Perhaps less expectedly, certain cases of vowel harmony turn out also to fall into this category. Although the classic non-linear treatment of harmony is uniformly cast in terms of spreading (composition in our terms), some types of vowel harmony are more appropriately analysed within the Government framework as instances of segmental reduction in governed positions. An example is the harmonic raising of mid vowels under the influence of a neighbouring high vowel, encountered in languages such as Pasiego Spanish and Menomini. The pattern is straightforwardly analysable as the loss of an operator A^+ from a governed nucleus when it is not licensed by an A^+ in the governing nucleus. (Recall that a mid vowel such as *e* is composed of I° and A^+. Subtraction of A^+ thus results in the raising of *e* to *i*.) The licensing role played by A^+ in this analysis has the effect of ensuring that a vowel occupying a governed position is never more complex than its governor. As such, it can be viewed as an instantiation of the Complexity Condition.

I have presented the details of the reduction analysis of harmony elsewhere (Harris 1990). Here I wish to focus on a rather different sort of potential reduction site defined at the level of nuclear projection, namely a position which, although itself not directly governed at this level of structure, intervenes between other positions which form a governing domain. At issue here are two contexts which have traditionally been identified as prime lenition sites: intervocalic and word-final position (e.g. Escure 1977). Many cases of lenition occur in both environments simultaneously (several of which I discuss presently), an observation which involves a curious disjunction when expressed in terms of segmental and word-domain conditions. Some syllable-based accounts have managed to unify the two contexts under the position coda: but this has been at the expense of introducing resyllabification machinery which is needed to move an intervocalic consonant into the coda of the first syllable (see, for example, the work of Kahn 1976 and Selkirk 1982 to be discussed below). Another approach has been to characterise the relevant environments in terms of metrical or prosodic domains (e.g. Nespor & Vogel 1986). This is the tack I will follow here. In particular, I will demonstrate how we can unify the two preferred lenition contexts under a single prosodic domain, defined in terms of phonological government, without having to resort to resyllabification devices.

The domain in question involves an onset which is sandwiched between nuclei which stand in a governing relation, as in (33) (illustrating left-to-right government):

(33)



This configuration unifies the two prime lenition contexts of intervocalic and word-final position. When necessary (since not all lenition processes operate in both environments simultaneously), the contexts can be distinguished by making reference to the content of the governed nucleus. Domain-final position is identifiable when, under 'Coda' Licensing, N_2 is empty. 'Intervocalic position' corresponds to a situation in which the governed nucleus is phonetically realised. The proposal made by Harris & Kaye (1988) is that segments occupying onset positions in this type of configuration (α in (33)) constitute potential 'barriers' to government at the level of nuclear projection. As such, they are under pressure to reduce in complexity. The notion 'barrier' here is purely metaphorical: onsets together with their associated segmental material are of course invisible at the level of nuclear projection. Formally, what is being described is a configuration in which an onset is licensed by a following nucleus which is itself governed from the left by another nucleus. Our proposal is that, if nuclei in a particular system display differences with respect to their ability to license segmental material in a preceding onset, then a governed nucleus will always possess less licensing capacity than a governing nucleus. Under such circumstances, the set of onset segments licensed by governing nuclei will include segments of a greater degree of elementary complexity than anything found in the set of onset segments licensed by governed nuclei. Any reduction effect observed in an onset followed by a governed nucleus thus reflects the latter's diminished segmental licensing power.

In the next section, we give detailed consideration to a class of decomposition processes in English which provide a particularly clear illustration of the phenomenon of complexity reduction in onsets licensed by governed nuclei.

5 Lenition of *t* in English

5.1 Introduction

In many types of English, *t* in certain phonological positions is subject to various lenition processes, the most widespread being glottalling, tapping and spirantisation. Very broadly speaking, tapping is firmly established in North America, Australia and some parts of Ireland and England. Glottalling is characteristic of many vernacular varieties in Scotland and England and some types of Caribbean English. Spirantisation is found in most types of Irish English and, as illustrated in (10), Liverpool English.

The analysis of the lenition facts to be presented in this section is based largely on that of Harris & Kaye (1988), who focus on glottalling and tapping in two dialects. Here I will extend the analysis to other varieties and to spirantisation.

Tapping (sometimes also known as flapping) in English refers to the realisation of *t* (and *d*) as an alveolar tap in certain positions, as in *ci[ɾ]y*, *Pe[ɾ]er*. The process is identical to $t \rightarrow r$ in Korean and is straightforwardly represented, as in (34b), as the loss of the elements ʔ° and h° from the internal composition of *t*:

(34)

a. plosive	b. tapped	c. glottalled	d. spirantised
x	x	x	x
|	|	|	|
R°	R°	|	R°
|		|	|
ʔ°		ʔ°	|
|			|
h°			h°

Under glottalling, *t* is realised with glottal constriction and no supraglottal articulatory gesture, as in *ci[ʔ]y*, *Pe[ʔ]er*. (The term GLOTTALISATION can be reserved for glottal constriction without loss of supralaryngeal closure.) In representational terms, glottalling involves the loss of both R° (debuccalisation) and h° (see (34c)).[9]

In the spirantising dialects, lenited *t* is produced with close approximation between the tongue tip and the alveolar ridge. The apical gesture may be non-grooved, in which case the resulting non-sibilant slit fricative (transcribed here as [ṡ]) remains distinct from grooved sibilant *s*, e.g. *letter* (with [ṡ]) ≠ *lesser* (with [s]), *ci[ṡ]y*, *Pe[ṡ]er*. As shown in (34d), spirantisation is characterised as the loss of ʔ°.[10] A more advanced stage in this process is reflected in the Liverpool pronunciation of function words ending in *t*, illustrated in (10b). Here the spirantised reflex is further weakened by debuccalisation to *h*, a development that involves the loss of R° from (34d).

Although the data to be discussed below were elicited from a relatively small number of speakers, it seems quite likely that the salient lenition facts described are broadly representative of much wider communities. We will consider five systems, to be referred to as Fife (Scotland), Leeds (Yorkshire), New York City, Dublin and London. The geographical terminology is simply a matter of expository convenience and is not meant to imply a belief in the existence of static homogeneous linguistic systems restricted to particular regions. In addition to the areal dimension, the distributional extent of lenited reflexes in individual systems varies according to a range of social and stylistic factors. Lenition appears to have advanced furthest in less standardised varieties and tends to be favoured in less formal styles and in faster speech tempos. In their work on glottalling in British dialects, Leslie (1983, 1989) and Broadbent (1985) have demonstrated that a less restricted phonological incidence of glottalled variants is typical of innovating vernacular varieties. It is thus possible that some of the distributional differences which I ascribe here to regional factors are just as likely to reflect social differences. What is of immediate interest here is the internal structure of these lenition systems;

we must leave it to further research to provide us with a more accurate picture of their social and geographical distribution.

The main lenition types represented in our illustrative systems are as follows:[11]

(35)	Glottalling:	Fife, Leeds, London
	Tapping:	New York City
	Spirantisation:	Dublin

5.2 Conditions on *t*-lenition

5.2.1 *The lenition site.* Kahn (1976) was one of the first to recognise that the correct statement of the conditions under which English tapping operates is in terms of syllable rather than purely segmental structure. His analysis has been extended, with the necessary refinements, to glottalling by Leslie (1983) and to other aspects of plosive allophony (including glottalisation) by Gussenhoven (1986). These accounts as well as Selkirk's (1982) reanalysis of tapping are formulated within a framework in which universal syllabification principles (based on onset maximisation) are supplemented by language-specific rules which add or modify syllable structure. Central to the Kahnian analyses is the claim that the lenition process is fed by a rule of Right Capture (Kahn's Rule III), which assigns ambisyllabic status to consonants under certain stress and segmental conditions. Selkirk (1982) dispenses with ambisyllabicity by having an equivalent rule which, under more or less the same conditions, moves an onset consonant into a coda, in which position *t* undergoes tapping. (All of these analyses actually break the lenition process into two stages, a precedent I will follow up in §5.3.)

An analysis along these lines is ruled out in principle within Government Phonology, according to which syllable structure is universally determined and, under the Projection Principle, cannot be interfered with by language-particular resyllabification rules. As I will demonstrate, the *t*-lenition facts can still be accommodated within this more tightly constrained framework.

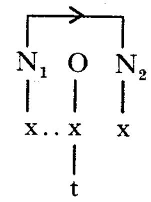
The data to be discussed below are presented in word groups, each of which illustrates a particular configuration of phonological conditions in which *t* occurs. For each of the five illustrative dialects, one set of data is positive (indicating that *t* can be lenited in that particular environment), while a second set is negative. Positive data are marked ✓, negative *. Where a word contains more than one orthographic ⟨t⟩, the emboldened letter corresponds to the *t* which appears in the phonological context illustrated by that particular group of words (e.g. ***vitality***).

Let us note right away the main context in which *t*-lenition does not operate. None of our illustrative dialects shows lenition when *t* occurs in the onset of a tonic syllable:

	Lon	Lee	Fif	NYC	Dub	
(36)	*	*	*	*	*	time, retain, entertainment

I begin the analysis by restating the claim made by Harris & Kaye (1988) that *t*-lenition operates in the prime reduction site depicted in (33) and repeated here with a slight modification to be explained presently:

(37)



That is, *t* is subject to lenition when it occupies an onset that is flanked by nuclei in a governing relation. (Government at the level of nuclear projection is head-initial in English.) A full specification of the conditioning factors present in (37) would involve us in examining the following: (a) the content of N_2, (b) the prosodic domain defined by the relation between N_1 and N_2, and (c) the potential influence of any position which intervenes between the onset and either of the two flanking nuclei. Each of these is discussed in detail by Harris & Kaye (1988). Here I will focus only on the content of N_2 and on the effect of a preceding 'coda' consonant.

5.2.2 *Filled* vs. *empty nuclei.* A first point of difference among the various leniting dialects under examination concerns the nature of the governed nucleus in (37). Recall from §4.2 that phonetically empty final nuclei are licensed in English. If N_2 in (37) is empty, all of our illustrative dialects with the exception of New York City show lenited reflexes of *t*. This configuration occurs whenever *t* appears word-finally followed by a pause (‖) or a consonant-initial word:

	Lon	Lee	Fif	NYC	Dub	
(38)	✓	✓	✓	*	✓	let ‖, put ‖, late ‖
	✓	✓	✓	*	✓	let me, put by, late night

In London, Leeds and Fife, we find, for instance, *cu[ʔ]*, while in Dublin we find *cu[ṡ]*. Tapping does not occur in this position in New York City; instead we find an unreleased preglottalised stop. However, the tapped reflex does show up if a vowel-initial word follows:[12]

	Lon	Lee	Fif	NYC	Dub	
(39)	✓	~	✓	✓	✓	let it, put off, late again

I will discuss the significance of the tap–stop alternation below.

If, on the other hand, the configuration in (37) defines a metrical foot, that is, if the governed nucleus is phonetically filled, a different distributional pattern is evident. In this case, Leeds is the only one of the dialects in which lenition does not operate:

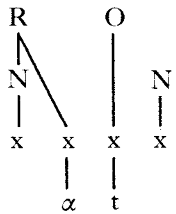
(40)	Lon	Lee	Fif	NYC	Dub	
	✓	*	✓	✓	✓	pretty, water, matter

Regarding the role of the governed nucleus in conditioning lenition, the present account predicts four types of system: one in which lenition only applies before a filled nucleus, another in which the process only applies before an empty nucleus, a third in which the process applies before both types of nucleus, and a fourth in which the process fails to apply before either type. Any non-leniting dialect exhibits the last pattern. Each of the three other types is attested in at least one of our illustrative dialects:

(41)	N_2 empty	N_2 filled	
	✓	*	Leeds
	*	✓	NYC
	✓	✓	London, Fife, Dublin

5.2.3 *Protected environments.* We turn now to an examination of a potential lenition context in which a rhymal position intervenes between the onset occupied by *t* and the governing nucleus in (37):

(42)



The lenition facts in this environment can be summarised as follows: lenition is categorically blocked if α in (42) is an obstruent and is favoured if *t* is preceded by a historical resonant. The latter tendency is particularly apparent if the resonant has been subject to vocalisation. In that case, the phonological conditions are identical to those in which a historical resonant was never present, and the lenition facts line up accordingly.

None of our dialects shows lenition if *t* is immediately preceded by an obstruent:

(43)	Lon	Lee	Fif	NYC	Dub	
	*	*	*	*	*	fist, past, left, draught
	*	*	*	*	*	fact, apt, crept
	*	*	*	*	*	chapter, doctor, after

This constitutes an example of a 'protected' environment, in which *t* appears to be shielded from lenition by the preceding consonant.

In the case of a preceding historical resonant, there is a certain amount of interdialectal variability with respect to whether *t* lenites, and this is partly dependent on whether the resonant has undergone vocalisation. Let

us begin by considering historical *lt* sequences. In both London and Fife vernacular, the (velarised) *l* is vocalised to a high back glide in this context, and *t*-lenition operates exactly as in etymologically postvocalic environments. Compare (44a) and (44b) with (38) and (40) respectively:

(44)	Lon	Lee	Fif	NYC	Dub	
a.	✓	✓	✓	*	*	fault, belt, bolt
b.	✓	*	✓	*	*	shelter, revolted, Walter

Dublin and New York City show little or no evidence of *l*-vocalisation, and neither system displays *t*-lenition in this context. The same blocking effect is apparent in more standardised London usage; whenever *l*-vocalisation is avoided, *t* tends not to be glottalled, e.g. [bɪʊʔ] ~ [bɪɫt] *built*.

Vocalisation seems to have a minimal impact on lenition in historical *rt* sequences; generally speaking, *t* lenites here irrespective of whether the system is rhotic or not. Fife and Dublin are rhotic; London and Leeds are non-rhotic; rhoticity in New York City is sociolinguistically variable. Compare (45a) (following empty nucleus) with (38) and (45b) (following filled nucleus) with (40):

(45)	Lon	Lee	Fif	NYC	Dub	
a.	✓	✓	✓	*	✓	hurt, cart, curt, start
b.	✓	*	✓	✓	✓	quarter, party, forty

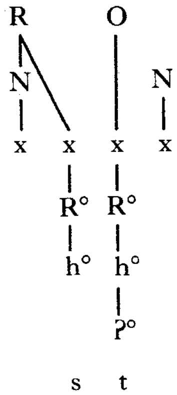
Vocalisation of postvocalic *n* usually involves not only a loss of consonantal closure but also a transfer of nasality onto the preceding nucleus. Under these conditions, historical *nt* sequences generally behave just like historically non-nasal contexts with respect to *t*-lenition. In New York City, tapping in this context usually yields a nasalised tap, e.g. [wɪ̃ɾ̃ə] *winter*. Vocalisation of *n* is well established in all of our dialects except Dublin. From the perspective of the analysis of these facts to be presented below, it is significant that, of the five dialects, Dublin is the only one not to show *t*-lenition in this context:

(46)	Lon	Lee	Fif	NYC	Dub	
a.	✓	✓	✓	*	*	hint, paint, bent
b.	✓	*	✓	✓	*	winter, plenty

In previous treatments of the phenomenon, these distributional tendencies are characterised as a feature condition on the lenition rule. Specifically, a preceding segment must be [−consonantal] (Kahn 1976; Selkirk 1982) or [+sonorant] (Leslie 1983) before it triggers lenition.

The present analysis of the same facts invokes the Complexity Condition. The specific proposal advanced in Harris & Kaye (1988) is that segments which discharge governing responsibilities are immune to processes whose effect is to reduce complexity. Take, for example, the transsyllabic sequence *st* in a form such as *plaster*:

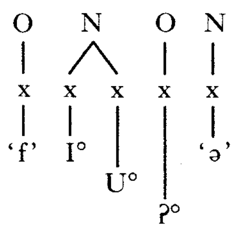
(47)



In this configuration, *t* governs *s* (by interconstituent government). In line with the Complexity Condition, the governing segment has a more complex elementary profile than its governee. Any decomposition of *t* in this context would have the undesired effect of cancelling or even reversing the complexity slope between the two segments. Thus lenition is prevented from occurring in this environment.

Compare this state of affairs with historical resonant–*t* sequences, particularly where the effects of vocalisation are in evidence. The historical consequence of vocalisation in this context is constituent restructuring, with the position occupied by the vocalised resonant being absorbed into the preceding nucleus. This is illustrated in (48) by the form *filter* with glottalled *t*:

(48)



filter

The absorption of the historical resonant into the preceding nucleus has the effect of removing the rhymal complement position which was originally governed by the following onset. Thus relieved of its governing responsibilities, an onset *t* is free to undergo decomposition without falling foul of the Complexity Condition.

This analysis can be straightforwardly extended to historical *nt* and *rt* sequences. Like *l*-vocalisation, a development such as *Vnt* → *Ṽʔ* (e.g. *wɪntə* → *wĩʔə*) results in the absence of a governed rhymal position. The fact that tapping and spirantisation occur freely in *rt* contexts, irrespective of whether *r* has undergone vocalisation (see (45)), suggests that this sequence has never contained a governed rhymal complement and supports

the position that preconsonantal *r* is syllabified within the nucleus (as also argued for by, among others, Pike 1947 and Levin 1985).

The role of governing obligations in blocking segmental reduction could be illustrated by any number of lenition systems. To take just one further example, consider the weakening of *b, d, g* to *β, r* (= [ɾ]), *γ* in the Austronesian language Murut spoken in Sabah state, Malaysia (data from Prentice 1971). All three of these consonants lenite postvocalically in some dialects, including the Poros dialect of Timugon Murut. In others, including the Paluan dialects of Highland Murut, only one or two members of this series lenite, and then in some cases only optionally. However, in a pattern that resembles the spirantisation of *b, d, g* in Spanish, no dialect exhibits weakening word-internally after a 'coda' consonant (which, given the syllable structure conditions of the language, can only be a nasal). Compare the postvocalic examples in (49a) with the postnasal examples in (49b) (Poros dialect):

(49) a. V —

nakabala	→ nakaβala	'has informed'
abag	→ aβaγ	'loincloth'
maduol	→ maruol	'painful'
maŋudad	→ maŋurar	'will scrub'
limog	→ limoγ	'dew'
maguyum	→ maγuyum	'will look for'

b. N —

mambalaʔ	'will inform'	ambay	'mistress'
indaγu	'speak!'	iγondoʔ	'once'
lumoŋgoʔ	'will cease'	iŋgonom	'six times'

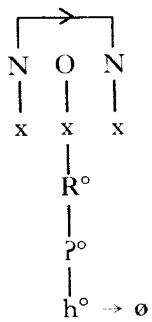
5.3 A two-stage analysis of *t*-lenition

In discussing the forms in (38)–(39), I referred to a pattern which we find in New York City and other tapping dialects, whereby the tap alternates with an unreleased stop in certain positions. Specifically, the unreleased variant shows up word-finally in prepausal position or before a consonant-initial word (e.g. *write* ‖, *write to*). The tap only occurs if a phonetically realised nucleus follows, as in *writer*, *write it*. This pattern is also evident when the following syllable is stressed (as in *ge[ɾ] on*), even though tapping fails to apply in such stress configurations when they occur word-internally, e.g. **bou[ɾ]íque*. This suggests that the distribution of the tap *vs.* the unreleased stop is conditioned not by the governing relations holding between the flanking nuclei but by the content of the following nucleus.

Generally speaking, we can say that the sum of the contexts in which tap and unreleased *t* occur is equal to the sum of the contexts in which London and Fife have glottal stop. To capture this underlying distributional relationship, I wish to propose a two-stage reanalysis of *t*-lenition, with a preliminary process being shared by New York City, London and Fife. (I assume that an unchanged one-stage analysis is sufficient to handle the Dublin and Leeds patterns.) The two-stage solution is justified in so far as the two stages can be shown to be subject to different phonological conditions.

In an earlier treatment of these facts (Harris & Kaye 1988), it was argued that the initial stage of lenition involves the breaking of *t* in context (37). (As described in §3.4, breaking refers to a process of decomposition without element loss in which the structure of a segment is rearranged into that of a contour segment.) Under the reanalysis to be presented here, I propose that the initial lenition process involves the loss of h° from the internal structure of *t*. This results in a reflex without noise release:

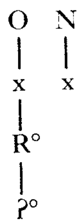
(50) t-*lenition – stage 1*



The various leniting dialects then diverge in the ways in which the decomposed structure in (50) is subsequently affected by further element depletion. As before, glottalling involves loss of R°, while tapping involves loss of ʔ°. The conditions under which the secondary decomposition processes occur are precisely those set out in (41). That is, secondary loss is sensitive to whether the following governed nucleus is phonetically realised or not:

(51) t-*lenition – stage 2*

Context:

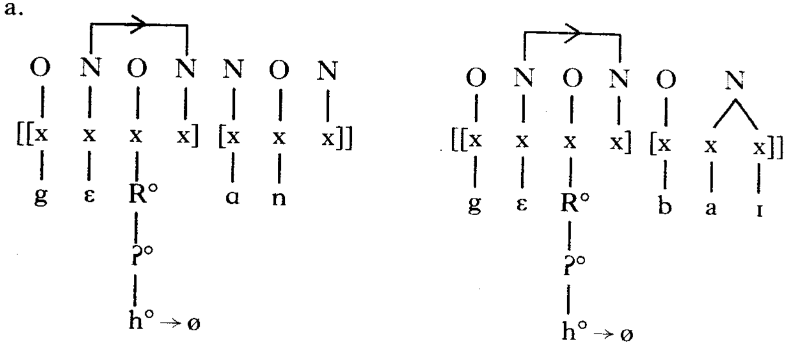


Process:

		N empty	N filled
London, Fife:	R° → ø	✓	✓
NYC:	ʔ° → ø	*	✓

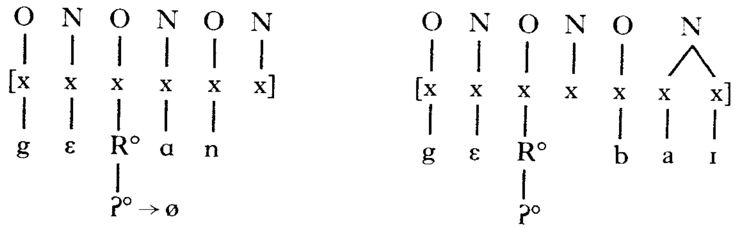
We are now in a position to account for the complementary distributional relationship between the tapped and unreleased reflexes of *t* in tapping dialects. Consider the following derivations of *get on* and *get by*. The preliminary loss of h° affects both forms on the inner cycle:

(52) a.



Note that on this cycle the position occupied by *t* is followed by an empty nucleus. Secondary loss of ʔ° is thus inapplicable, since, according to the conditions given in (51), it is triggered by the presence of a following filled nucleus. On the next cycle, however, a filled nucleus becomes available in the form *get on*, and loss of ʔ° duly occurs:

(52) b.



(Under the OCP, an empty nucleus deletes next to another nucleus.) The correct result is achieved: *t* is realised preconsonantally as an unreleased stop in *get by* and intervocalically as a tap in *get on*.

In a form such as *boutique*, *t* is never subject to reduction, for the reason that, although it is followed by a filled nucleus, it never undergoes the initial decomposition process (50) which provides the input to tapping. Since it occupies the onset position of a stressed syllable, it does not occur within the governing domain necessary for h° loss.

Note that the derivation depicted in (52) does not involve anything resembling extrinsic rule ordering. The secondary reduction processes in (51) are intrinsically fed by the initial h°-loss process (50); and this is fully in accord with the principle that phonological events occur freely whenever their conditions are met.

A further point of note concerns the status of elements in the two-stage characterisation of tapping. In some ways, the two-process aspect of this analysis is reminiscent of the treatments of tapping proposed by Kiparsky (1979) and Selkirk (1982). Kiparsky captures the distributional relationship between the tap and the unreleased stop by having the feature value [+lax] assigned to *t* in the contexts in which these two reflexes occur; the laxing rule then feeds tapping in the relevant context. Selkirk's solution is to claim that the two reflexes occur in the same basic syllabic environment (syllable-final under her analysis) but that they are derived in complementary segmental contexts through the assignment of values for the feature [±release]; [+release] triggers tapping. Inherent in both of these accounts is one of the general weaknesses of feature orthodoxy discussed in §3.1, namely the arbitrariness (and in the case of [±release] the ad hoc nature) of the features and their values that are manipulated by rules during the course of a derivation. In this case, the theory provides no particular reason why we should expect [+lax] or [+release] to be assigned to *t* in this set of contexts, rather than the opposite values for these features or indeed any other feature. Under the present account, on the other hand, both stages of the lenition process involve the loss of phonological atoms which are already present in the lexical representation of *t*.

6 Strengthening

The question now arises as to whether the principles underlying the present treatment of lenition can be extended to fortition. One aspect of the analysis extends fairly straightforwardly: if weakening involves decomposition, then strengthening involves composition, the addition of one or more elements to the internal structure of a segment. A second aspect has to do with the establishment of a direct link between a process and its operating context. Since composition operations only have access to elements which are lexically present in representations, the analysis implies that the source of an additive element should always be found in a neighbouring position. In other words, fortition is simply assimilation.

The prediction that strengthening is always locally triggered is by and large borne out. However, apparently spontaneous cases of fortition are occasionally reported in the literature, and these typically involve geminates (see, for example, Lass & Anderson 1975). One example is the intervocalic strengthening of Latin *y* in some Romance languages, e.g. Latin *mayor vs.* Italian *majjore*. Another is Holtzmann's Law in Germanic, in which Proto-Indo-European intervocalic **ww* and **jj* shift to *gg* and *dd* respectively in some dialects (Lass 1984: 181). In such cases, the strengthening consonant acquires an element, ʔ°, which is not locally present in the representation. Viewing geminates as interconstituent governing domains in which segmental material is distinctively lodged in the governing position and spreads into a lexically empty governed position (see §§4.4–4.5), we can see that the effect of such a process is to steepen the interconstituent complexity slope. The strengthening propensity of geminate positions is likely to be related to another of their characteristics: their inalterability (Hayes 1986b). That is, they have a tendency to behave as protected environments when lenition processes affect other internuclear contexts. Whether geminate strengthening and inalterability effects reflect some universal markedness principle which

favours the optimisation of complexity differentials is an issue for further research.

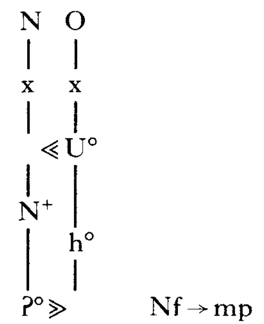
In other than geminate positions, instances of strengthening can almost always be shown to have some local cause. One widespread type involves so-called nasal mutation. A reasonably typical example is found in many Bantu languages, where a series of fortition processes comes into play whenever a stem-initial onset consonant is preceded by a nasal prefix. In Sesotho, part of this pattern involves the shift of *r* and *f* to (non-glottalised) *t* and *p* respectively, as in (53a), and of other fricatives to homorganic affricates, as in (53b). (N here represents the 1st person singular object marker.)

(53)		Stem	N+Stem	
	a.	rat'a	ntat'a	'love'
		fep'a	mpep'a	'feed'
	b.	siya	ntsiya	'leave'
		šap'a	nčap'a	'beat'
		xolwa	ŋkxolwa	'believe'

(See Schaefer 1981 for a strength-hierarchical analysis of the cognate pattern in Setswana.)

These alternations are analysable as the spreading of ʔ° from a nasal stop onto a following consonant. In the case of *r* and *f*, ʔ° fuses with the elements that are lexically present in each of the continuants to produce a homorganic plosive. (The homorganicity is achieved independently by the spreading of the place element into the position occupied by the nasal.) This process is illustrated below:[13]

(54)



In the case of the fricatives exemplified in (53b), a contour structure is created, with the results of ʔ°-spreading appearing in the first portion of the affricate. (Cf. Clements' 1987 treatment of intrusive stops in nasal–fricative clusters as involving the spreading of [−continuant] from the nasal.)

7 Conclusion

To recap: the theory of segmental structure I have presented here is founded on two main assumptions. First, sonority and strength effects are uniformly expressible in terms of elementary complexity. In fact, from the viewpoint of the element-based model, strength and sonority are simply different labels for the same phenomenon occurring in different structural positions. Second, there is a direct correlation between the relative complexity of a segment and the governing role assumed by the position it occupies. In particular, as expressed in the Complexity Condition (23), a segment associated with a governed position may never be more complex than its governor.

I examined complexity effects in directly governed positions within constituent and interconstituent domains. Within branching onsets and between an onset and a preceding rhymal complement, a sloping complexity differential is universally enforced between a governor and its governee. Within branching nuclei, on the other hand, zero complexity differentials are tolerated. Although not discussed here, this less stringent implementation of the Complexity Condition also characterises internuclear governing domains in some languages (see Harris 1990). One task for future research is to investigate the source of this apparently systematic difference between nuclei and other domains of government.

I also examined a number of reduction phenomena which operate within a domain defined at the level of nuclear projection but which occur in positions that are themselves not directly governed at this level of structure. In particular, I identified a prime reduction site as one in which a consonant occupies an onset position that is flanked by nuclei in a governing relation. The internuclear-domain aspect of the analysis enjoys a number of advantages over competing syllable-based treatments of lenition. For one thing, it allows us to unify particular lenition environments under a single domain without having to resort to resyllabification devices. For another, it provides an explanation for why a consonant is protected from lenition in certain contexts, specifically when it occupies a position which has constituent or interconstituent governing obligations to fulfil.

NOTES

* My thanks are due to Monik Charette, Jonathan Kaye and Geoff Lindsey for their helpful comments on earlier drafts. The usual disclaimers apply, not least because, for reasons of stubbornness or whatever, I've declined to incorporate all of their suggestions.

[1] Thanks to Sang Jik Rhee and Yong Heo for supplying and discussing the Korean data in (1).

[2] Throughout this paper, I will follow the practice of underlining the head of a compound segment only when this is directly relevant to the immediate discussion.

[3] All of these patterns also tend to display place-of-articulation preferences. It is

frequently noted that consonants arrange themselves on the following scale in terms of their propensity to be affected by lenition processes: velars > labials > coronals (see, for example, Foley 1977). However, these preferences are not as consistent as those obtaining for the manner dimension and are subject to a degree of cross-linguistic variability. For example, as we will see in §5, coronals appear to be the 'weakest' series in English. Eventually, phonological theory should provide some account of this phenomenon, but to attempt to do so here would take us beyond the scope of the present study.

[4] Thanks to Thaïs da Silva for supplying and discussing the Brazilian Portuguese data in (8a).

[5] Changes in the strength of a segment inevitably entail changes in sonority. The latter dimension has also been represented in terms of the hierarchical model, although in this case implicational relations have usually been identified on the basis of phonotactic considerations (e.g. Vennemann 1972; Hooper 1976). I discuss more recent attempts at characterising sonority relations in §4.4.

[6] The literature contains examples of alleged onset clusters which appear to contradict the view being defended here. One class of examples involves word-initial *s* + consonant sequences. Under some analyses, these are treated as trans-syllabic clusters in word-medial position but as onset clusters in word-initial position. It can be demonstrated, however, that this vacillating behaviour is unmotivated and that the treatment stems from a misguided assumption that any well-formed word-initial consonant sequence automatically qualifies as a well-formed onset. Rather, *s* + consonant sequences are uniformly heterosyllabic, including in word-initial position, where the *s* has been variously analysed as occupying an extrasyllabic slot or a 'coda' position preceded by an empty nucleus. For a full discussion of this issue, see KLV (this volume). A similar point can be made with respect to another class of supposed onset clusters, in which the right-hand slot is filled by a stop or fricative (*kt*, *pn*, *kn*, *ps* and the like). These too can be shown to be heterosyllabic; either the first member appears in a 'coda' position, or the two consonants occur in separate onsets with an intervening empty nucleus. The latter analysis is illustrated by Kaye's (1990) treatment of Moroccan Arabic, which displays apparent clusters of this type.

[7] Apparent counterexamples such as *hotly* or *Batley* do not contain genuine trans-syllabic sequences, since an empty nucleus intervenes between the two medial positions occupied by the consonants *t* and *l*. In *hotly*, where an analytic morpheme boundary follows the *t*, the empty nucleus is present under 'Coda' Licensing ([[hɑtø]lɪ]]) (Kaye this volume). In *Batley* the empty nucleus is the historical residue of a once analytic structure ([bætølɪ]).

[8] Note that some of the derived forms in (30) have what appear to be long stem vowels, e.g. *neeʔté* 'lioness'. If these represented branching nuclei, this would indicate that the suffixes are cyclic, rather than non-cyclic as I am claiming here. In a non-cyclic domain, we would expect closed-syllable shortening before consonant clusters (cf. English *keep* ~ *kept*). However, the apparently long vowels are in fact nuclear sequences, as evidenced by their failure to display the integrity effects associated with true geminate structures (see Hayes 1986b). For example, the vocalic sequence is optionally split by a process which transposes the second portion and a following laryngeal consonant (Hayward 1984: 72). Thus a form such as *neeʔté* has a variant pronunciation *neʔeté*.

[9] McCarthy (1988) implies that debuccalisation to *ʔ* is restricted to consonants that already contain a glottalised component, as illustrated in the Arbore data. In feature-geometric terms, this is represented as the loss of all structure save the laryngeal node, which, in the case of a glottalic consonant, dominates the feature [+constricted glottis]. The latter defines a glottal stop once the relevant redundancy rules have applied. In fact, glottalisation is not a prerequisite for reduction to *ʔ*, as illustrated by the Burmese, Toba Batak and Malay facts mentioned in §3.3 as well as by various *t*-leniting dialects of English to be discussed

in §5. Under a feature-based analysis, debuccalisation in such instances involves either a switch in the value of [constricted glottis] from minus to plus or, if this feature is underlyingly unspecified, a spontaneous filling-in of the plus value. In neither case has the change any local motivation. In contrast, the element-based approach correctly predicts that, since all stop consonants contain ʔ°, all are susceptible to debuccalisation to ʔ, irrespective of whether or not they are glottalic.

[10] Due to limitations of space, I set aside the question of how the distinction between grooved and non-grooved *s* is represented in terms of element structure.

[11] For the Fife and Leeds material, I have relied entirely on the detailed work of David Leslie (1983, 1989). Data for New York City and London are from Harris & Kaye (1988).

[12] Leeds, in common with other north-of-England vernaculars, has its own special development in this context. In a pattern which seems to be subject to a degree of lexical selectivity, word-final *t* alternates with approximant *r* after a short nucleus and before a vowel, e.g. *ge[r] off*, *shu[r] up*. Historically, the alternation probably passed through an intermediate tapping stage. For the details, see Broadbent (1985).

[13] The consonantal sequences being discussed here are not prenasalised obstruents but clusters consisting of a syllabic nasal followed by an onset consonant. As illustrated in (54), the nasal in such clusters occupies a nuclear position. One piece of evidence supporting this analysis is that nasals in this position behave as independent tone-bearing units, just like vocalic nuclei.

REFERENCES

Amastae, Jon (1989). The intersection of *s*-aspiration/deletion and spirantization in Honduran Spanish. *Language Variation and Change* **1**. 169–183.
Anderson, John M. & Colin J. Ewen (1987). *Principles of dependency phonology*. Cambridge: Cambridge University Press.
Anderson, John M. & Charles Jones (1974). Three theses concerning phonological representations. *JL* **10**. 1–26.
Archangeli, Diana & Douglas Pulleyblank (forthcoming). *The content and structure of phonological representations*. Cambridge, Mass.: MIT Press.
Aronoff, Mark & Richard T. Oerhle (eds.) (1984). *Language and sound structure*. Cambridge, Mass.: MIT Press.
Bauer, Laurie (1988). What is lenition? *JL* **24**. 381–392.
Broadbent, Judith (1985). Aspects of Leeds phonology. Ms, Central School of Speech and Drama, London.
Brockhaus, Wiebke (1990). Colourful leagues: a government phonology approach to final obstruent devoicing in German. *UCL Working Papers in Linguistics* **2**. 270–297.
Browman, Catherine P. & Louis Goldstein (1989). Articulatory gestures as phonological units. *Phonology* **6**. 201–251.
Charette, Monik (in press). *Constraints on governing relations in phonology*. Cambridge: Cambridge University Press.
Clements, G. N. (1985). The geometry of phonological features. *Phonology Yearbook* **2**. 225–252.
Clements, G. N. (1987). Phonological feature representation and the description of intrusive stops. *CLS* **23:2**. 29–50.
Clements, G. N. (1989). A unified set of features for consonants and vowels. Ms, Cornell University.
Cornyn, William S. (1964). Outline of Burmese grammar. *Lg* **20**. Supplement.

Durand, Jacques (1986). On the phonological status of glides: the evidence of Malay. In John Anderson & Jacques Durand (eds.) *Explorations in dependency phonology*. Dordrecht: Foris. 79–107.
Escure, G. (1977). Hierarchies and phonological weakening. *Lingua* **43**. 55–64.
Farid M. Onn (1980). *Aspects of Malay phonology and morphology: a generative approach*. Bangi: Universiti Kebangsaan Malaysia.
Foley, James (1977). *Foundations of theoretical phonology*. Cambridge: Cambridge University Press.
Goldsmith, John (1989). Licensing, inalterability and harmonic rule application. *CLS* **25**. 000–000.
Gussenhoven, Carlos (1986). English plosive allophones and ambisyllabicity. *Gramma* **10**. 119–141.
Harris, John (1985). *Phonological variation and change*. Cambridge: Cambridge University Press.
Harris, John (1990). Reduction harmony. Paper presented at the 1990 GLOW phonology workshop, London.
Harris, John & Jonathan Kaye (1988). A tale of two cities: London glottalling and New York City tapping. Paper presented at the meeting of the Linguistic Association of Great Britain, Exeter.
Hayes, Bruce (1986a). Assimilation as spreading in Toba Batak. *LI* **17**. 467–499.
Hayes, Bruce (1986b). Inalterability in CV phonology. *Lg* **62**. 321–351.
Hayward, Dick (1984). *The Arbore language: a first investigation*. Hamburg: Helmut Buske.
Hooper, Joan B. (1976). *An introduction to Natural Generative Phonology*. New York: Academic Press.
Hulst, Harry van der (1989). Atoms of segmental structure: components, gestures and dependency. *Phonology* **6**. 253–284.
Hyman, Larry M. (1975). *Phonology: theory and analysis*. New York: Holt, Rinehart & Winston.
Itô, Junko (1986). *Syllabic theory in prosodic phonology*. PhD dissertation, University of Massachusetts, Amherst.
Iverson, Gregory K. (1989). On the category Supralaryngeal. *Phonology* **6**. 285–303.
Kahn, Daniel (1976). *Syllable-based generalizations in English phonology*. PhD dissertation, MIT. Published 1980, New York: Garland.
Kaye, Jonathan (1989). *Phonology: a cognitive view*. Hillsdale, NJ: Lawrence Erlbaum.
Kaye, Jonathan (1990). Government in phonology: the case of Moroccan Arabic. *The Linguistic Review* **6**. 131–159.
Kaye, Jonathan, Jean Lowenstamm & Jean-Roger Vergnaud (1985). The internal structure of phonological elements: a theory of charm and government. *Phonology Yearbook* **2**. 305–328.
Kiparsky, Paul (1979). Metrical structure is cyclic. *LI* **8**. 421–442.
Lass, Roger (1971). Boundaries as obstruents: Old English voicing assimilation and universal strength hierarchies. *JL* **7**. 15–30.
Lass, Roger (1976). *English phonology and phonological theory*. Cambridge: Cambridge University Press.
Lass, Roger (1984). *Phonology: an introduction to basic concepts*. Cambridge: Cambridge University Press.
Lass, Roger & John M. Anderson (1975). *Old English phonology*. Cambridge: Cambridge University Press.
Leslie, David (1983). Left capture and British voiceless stop allophony. Ms, University College London.
Leslie, David (1989). Lenition systems. Paper presented to the London Phonology Seminar, University of London.

Levin, Juliette (1985). *A metrical theory of syllabicity*. PhD dissertation, MIT.
Lindsey, Geoff & John Harris (1990). Phonetic interpretation in generative grammar. *UCL Working Papers in Linguistics* **2**. 355–369.
McCarthy, John J. (1988). Feature geometry and dependency: a review. *Phonetica* **45**. 84–108.
Maran, La Raw (1971). Burmese and Jingpho: a study of tonal linguistic processes. *Occasional Papers of the Wolfenden Society on Tibeto-Burman Linguistics* **4**.
Nespor, Marina & Irene Vogel (1986). *Prosodic phonology*. Dordrecht: Foris.
Ní Chasaide, Ailbhe (1989). Sonorization and spirantization: a single phonetic process? Ms, Trinity College, Dublin.
Pike, Kenneth L. (1947). *Phonemics*. Ann Arbor: University of Michigan Press.
Prentice, D. J. (1971). *The Murut languages of Sabah*. Canberra: Australian National University.
Prince, Alan S. (1984). Phonology with tiers. In Aronoff & Oehrle (1984). 234–244.
Rice, Keren D. (1990). On deriving sonority: a structural account of sonority relationships. Ms, University of Toronto.
Sagey, Elizabeth (1986). *The representation of features and relations in non-linear phonology*. PhD dissertation, MIT.
Schaefer, Ronald P. (1981). A strength hierarchy for Tswana. *Studies in African Linguistics* **12**. 114–117.
Schane, Sanford S. (1984). The fundamentals of particle phonology. *Phonology Yearbook* **1**. 129–155.
Selkirk, Elizabeth O. (1982). The syllable. In Harry van der Hulst & Norval Smith (eds.) *The structure of phonological representations*. Part 2. Dordrecht: Foris. 337–384.
Selkirk, Elizabeth O. (1984). On the major class features and syllable theory. In Aronoff & Oerhle (1984). 107–136.
Smith, Norval S. H. (1988). Consonant place features. In Harry van der Hulst & Norval Smith (eds.) *Features, segmental structure and harmony processes*. Part 1. Dordrecht: Foris. 209–235.
Vennemann, Theo (1972). On the theory of syllabic phonology. *Linguistische Berichte* **18**. 1–18.
Vennemann, Theo (1988). *Preference laws for syllable structure and the explanation of sound change*. Berlin: Mouton de Gruyter.
Vennemann, Theo & Peter Ladefoged (1973). Phonetic features and phonological features. *Lingua* **32**. 61–74.

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'Coda' licensing*

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0 Introduction

One of the main thrusts of the research programme known as Government Phonology has been the attempt to replace the rule component of a phonology by a group of universal principles common to all linguistic systems along with a series of parameters which delimit the nature of linguistic variation from one system to another. Given the wealth of analyses that employ rules and the fact that their number continues to grow, even to this day, it is a daunting task to find plausible alternative stories for each and every analysis that employs phonological rules in some crucial way. One of the leading ideas of work done on syllable structure that I have participated in for the last ten years has been the emergence of such alternative analyses for a series of phenomena that seemed to call for phonological rules.[1] Slow but steady progress has been made on formulating such principles and showing that many rule-based analyses could be successfully replaced by a syntax-like 'principles and parameters' approach.[2]

One of the earliest attempts to replace a rule-based account by something less arbitrary concerned the commonplace phenomenon of closed syllable shortening, i.e. a long vowel or heavy diphthong would shorten (or not occur) in a closed syllable. This phenomenon presented a challenge for our programme. It was difficult to see at first glance what the relationship was between the process, the shortening of a vowel, and the context in which it occurred, a closed syllable. In this paper I shall return to this phenomenon. I will sketch the history of its treatment and show the influence it has had on the evolution of government phonology. I will draw some conclusions about syllable structure that may, at first glance, seem entirely preposterous. It is my belief that there is an increasing amount of empirical support for the rather strange claims concerning syllable structure that emerge from the study of this phenomenon.