Coronal: the undesirable element

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1 Introduction

One of the principal aims of Government Phonology (henceforth GP) has been to curtail the massive over-generation of phonological expressions which results from the description of melody units in terms of the twenty or so SPE-type distinctive features. For Kaye, Lowenstamm and Vergnaud (KLV), the atoms of melodic representation belong to a relatively small set of autosegmentally arranged elements which impose a limit upon the number and nature of possible phonological processes, and also restrict the number of phonological expressions that may be formed via elemental fusion. Yet, although the theory has achieved considerable success in eliminating a large majority of the unattested expressions which could potentially be described using a feature-based model, the inventory of ten elements proposed in KLV 1990 still has the capacity for generating a significant number of expressions which are either unobserved or non-contrastive in the world's languages. But rather than imposing *ad hoc* constraints on the combinability of certain elements, a more satisfactory means of improving this position involves a reduction in the number of elements available in representations. To this end, I shall explore the possibility of eliminating R° from the element inventory whilst leaving intact the observed set of phonological contrasts.

I shall begin by identifying the coronal element as a likely candidate for exclusion. In general terms, evidence to support the presence of R° is rather less well established than the arguments used in the justification of the other so-called resonance elements. However, my proposal for rejecting R° is specifically motivated by an apparent violation of the Complexity Condition in English *s+C* clusters, a possible solution to which would involve formulating a simplex (ie. single element) representation for the coronal fricative [s]. Given the option of dispensing with either h° or R° from the internal structure of this segment, I shall loosely adopt the position held by many working within an underspecification framework, in which some doubt is cast on the status of coronality as a phonologically significant entity. The remainder of the discussion considers how the absence of the coronal element affects the system of melodic representation as a whole. In section 3 I propose that [s] be analysed in terms of unspecified oral friction; and on this basis I suggest that all coronal obstruents lack an overt phonological place specification, thus rendering them inherently less complex than their non-coronal counterparts. I shall highlight the advantages of this difference

in complexity by examining the anomalous behaviour of coronal segments in dynamic processes.

2 The issues

2.1 Phonotactic constraints

For decades it had been widely assumed that the permissible sound combinations within a syllable are arranged according to phonological strength and governed by a (perhaps universal) strength hierarchy. In GP however, the notion of strength in terms of articulatory gesture is abandoned in favour of the differentiation between segments according to their potential ability to govern other segments. The governor/governee relationship is central to the application of GP, and all segments must, at some stage of derivation, enter into such a relationship, the nature of which is determined by several properties of the melody units involved. Specifically, KLV (1990) stipulate that in order to be a governor, a segment should either be charmed or, if charmless, should be more complex than its governee. To test the validity of these requirements we can observe the distribution of segments in a branching onset, a governing domain in which the left position assumes the role of a head that governs the position to its right. The combinations given in (1) are permissible word-initial CC clusters in English. The data is taken from Gimson (1974: §9).

(1)

C1	C2									
oral stop	l	r	w	j	(but: *tl, *pw)					
nasal stop				j	(no initial velar)					
θ		r	w	j						
f	l	r		j						
š		r								
l				j						
s	l		w	j	m	n	f	p	t	k

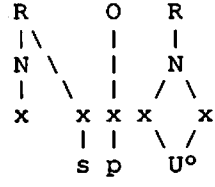
Disregarding word-initial [s] for the moment, we may note that, according to GP, most of the consonants in governing position are (negatively) charmed; the exceptions are [l] and the nasals. The status of [š] as a governor is perhaps open to question, and the matter will not be pursued here. Furthermore, all the segments in the complement position are charmless and also less complex than their governors. The case of [l, n, m] is not too problematic since, although charmless, they can govern only the simplex segment [j]. This provides strong support in favour of the conditions set out above, by illustrating the requirement that the

complexity constraint should necessarily hold whenever conditions on charm are violated by both governor and governee being charmless.

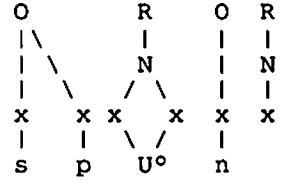
I now turn to the clearly exceptional cases of word-initial *s+C* clusters. Within the framework of GP, [s] is analysed as a segment consisting of two elements (R°, h°) , and one which is rendered charmless by virtue of the absence of a tonal element. And yet, by analogy with other CC clusters, [s] appears to occupy a governing position and have the strength to license not only charmless approximants (eg. in the word-initial clusters of *slide* and *sweet*) but also more complex nasals (eg. as in *snow*) and oral stops (eg. as in *stone* and *spin*). In short, its apparently omnipotent licensing capabilities force us to call into question the status of *s+C* clusters as true branching onsets.

This topic is addressed in Kaye (1992), who, with ample justification, proposes a universally heterosyllabic analysis of *s+C* clusters. With respect to the superficially anomalous cases of word-initial *sC* sequences mentioned above, this means that words like *spoon* will always be syllabified as in (2a) and never as (2b):

(2) a.



b.



By adopting this analysis we need no longer treat such clusters as exceptions within the group of static distribution patterns given in (1). The reason for this is that [s], in these instances, will always be syllabified in the rhyme rather than in the onset head position; and hence, it will typically be required to fulfil the role of a governee and not a governor.

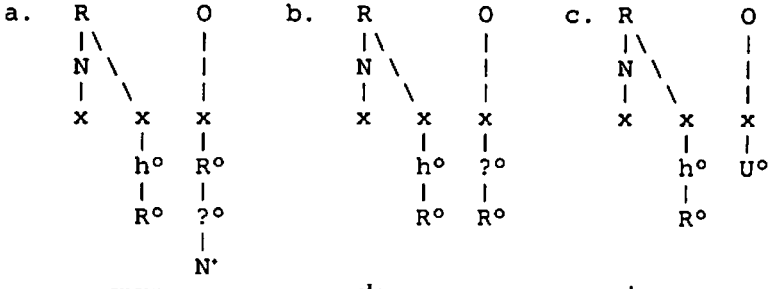
We expect a governee to be both charmless and less complex than its governor - a reversal of the conditions required of a typical governor; and the empirical nature of the issue allows us to test the validity of this stipulation by direct observation of the word-initial *sC* sequences in English, repeated here:

(3)	s	+	y, w,	(simplex governor)
	s	+	l	(two-element governor)
	s	+	n, m	(three-element governor)
	s	+	p, t, k, f	(three-element governor)

At least in the case of consonants, the requirement that charmed segments should govern charmless ones appears to be more of a trend or a preference rather than an

absolute stipulation. Two examples of neutrally charmed governors have already been cited - eg. the sequence [lj] forms a permitted branching onset in English. In this instance, however, it seems that the complexity condition does play a role in excluding impossible word-initial CC clusters such as [ln]. This seems equally true of the *s+C* clusters, where examples of charmless governing charmless are common, but in which the relative complexity of both positions becomes significant. The rhyme-onset sequences involving a governor more complex than its governee are well-formed, as in (4a); and even consonant clusters involving segments of equal complexity are tolerated, as illustrated in (4b).

(4)



It should be noted that the situation illustrated in (4b) does not, strictly speaking, adhere to the conditions required of a governing relationship as set out in KLV (1990), since the constraint on segmental complexity does not allow for the possibility of a governor and governee being both charmless and of equal complexity. Clearly, the KLV stipulation, that a neutrally charmed segment may govern if its complexity is greater than that of its governee, is rather too restrictive. This fact is recognized and discussed in Harris (1990), who proposes a relaxation of the complexity condition to the effect that a governor must be no less complex than its governee. With this modification it is now possible to eliminate the potentially troublesome cases such as that represented in (4b). The problem, however, lies with cases such as (4c), in which both governor and governee are neutral segments; furthermore, the governor is even less complex than its governee. And Kaye acknowledges the difficulty of incorporating these clusters into the overall framework by labelling them "unnatural (transconstituent) sequences" (1992: §6). If the *s+glide* sequences in words such as *sweet* and *sewer* [sjuwə] are the only indisputable exceptions to the complexity condition, then any attempt at a neater and more generalized explanation of English phonotactic restrictions should perhaps take as its starting point not the complexity condition itself but the

complexity (ie. the internal representation) of the segments that create these apparent exceptions - namely, [s] and the glides [j, w].

For some time the two English glides [j] and [w] have been standardly analysed as non-nuclear equivalents of the high vowels [i, u]. This is reflected in their segmental representation within GP, which treats them as the manifestation of the I° and U° elements respectively, in non-nuclear positions. Since there is no reason to doubt the validity of this widely held position, there remains only the task of re-analysing the internal composition of the segment [s] so that apparent violations of the Complexity Condition, as demonstrated by the problematic example in (4c), need no longer arise. Ultimately, this means a rejection of the current GP analysis of [s] as (R°, h°) in favour of a simplex representation which will result in the governing conditions set out in (4b) for words such as *sweet* and *suit* [sjut] as well as for *sleet*. Logically, there are three possible routes to such a goal:

i) to abandon the h° element, thus leaving R° to represent [s];
ii) to abandon the R° element, thus leaving h° to represent [s];
iii) to abandon both h° and R° and adopt an all-new representation.

In the remainder of this section I consider, and ultimately reject, the third of these options.

No matter which way we choose to represent the internal structure of a particular segment, the choice will unavoidably affect the representation of other segments too. This is, of course, a feature of any well-formulated theoretical framework which is intended to capture both the sets of segmental oppositions that characterize any phonological system and also the natural groupings into which sounds are organized according to their participation in phonological processes. With respect to the issue of a simplex representation of [s], I suggest that a rejection of (R°, h°) in favour of some newly-postulated element, say S°, does not amount to a feasible option. Although this move would solve the immediate problem of the apparent violation of the Complexity Condition, the overall detrimental effects on the representation system as a whole would greatly outweigh any advantage to be gained from a more satisfactory description of phonotactic constraints. The postulation of an element S° to represent a coronal fricative would necessitate a radical reanalysis in two areas of the inventory - in the class of obstruents (ie. those segments containing the h° element) and in the class of coronals (ie. the set containing R°) - if the interrelatedness between segments that is explicitly expressed in the present system of representation (as set out in KLV 1990) is to be retained. Clearly the loss of this explicit means of demonstrating phonological relationships would greatly undermine the value of any explanatory theory.

Further problems created by the addition of another element to the inventory include the capacity for overgeneration. It is unlikely that the introduction of an element such as S° could altogether replace the R° and h° elements which constitute the original representation of [s]. This is based on the assumption (which would, of course, need to be proven) that a single element S° could not cover the same empirical ground or match the combined expressive power of a 'place' feature such as R° and a 'manner' feature such as h°. The introduction of S° would therefore result in an increase in the size of the element inventory and thus a consequential decrease in the restrictive characteristics of the model. In conclusion therefore, it would be counter-productive to pursue the option of adopting a new element in order to arrive at a revised representation of [s]. Instead, the task has become one of re-defining the status of either R° or h° (but ultimately both) so that one of these may be phonetically interpretable in isolation as a coronal fricative.

2.2 The function of R°

In this section I consider the group of elements informally referred to as the resonance or place-defining elements, comprising I°, U°, A^+, v° and R°. In general, the task of justifying the presence of these objects appears to be a relatively straightforward one when we observe the behaviour of the segment classes they define and the phonological processes they undergo. For instance, it is possible to refer to the numerous harmony processes in which either I° or U° may be seen as dominant. To these can be added the notion of head alignment or v° spread, and also the A^+-element height harmony observed in, for example, some central Bantu languages such as Chichewa. So, there seems little difficulty in finding evidence which, in some sense, accounts for these four elements in phonological representations.

However, with respect to the one remaining resonance element R°, the corresponding arguments are, at best, sketchy and unconvincing. We do not, for instance, ever see R° as the active element in any harmony processes. Likewise, R° never participates as the active element in any short-distance assimilatory or spreading processes. With respect to cases of homorganic *nasal+stop* clusters involving coronals, I shall argue below that, with the representation of coronals to be formulated here, these do not come about via any place assimilation process as such. In fact, the only objectively observable manifestation of the coronal element that remains largely undisputed is its simplex interpretation as a tap, often constituting the result of a segmental decomplexification process affecting coronal stops (occurring for example, in English and Korean). Otherwise, it is difficult to

present the kind of evidenced justification for the presence of R° which will match that available for the other resonance elements proposed by KLV.

We are therefore forced to recognized that R° should not be viewed as a place-defining phonological primitive in the same way that I° U° v° and A^+ are analysed. The relative inertia of the coronal element is emphasized in its characteristic resistance to participation in phonological processes and in its lack of expressive diversity according to the contribution it makes to a compound segment. This latter point is demonstrated by the observation that R° does not possess the dual-function characteristics - attributable to its status as either the head or an operator of an expression - that the other place elements typically share. Specifically, the contribution made by R° to a compound melody unit is the same, regardless of whether the element assumes head position or not - hence, the non-existence of 'coronalized' consonants. (5) shows the internal composition of three segments from the phonological inventory of English, all of which contain the element R° (the rightmost element constitutes the head):

(5) a. [d] = (h° ?° R°)

b. [n] = (L° ?° N^+ R°)

c. [s] = (R° h°)

In (5a) the combined elements ?° and h° represent a released stop to which R°, the head of the expression, contributes only the place specification **coronal** to indicate whether oral occlusion is to occur. A similar contribution is made by R° in (5b). In contrast, example (5c) shows the R° element in the operator position. However, this appears to make little difference to the function of the element, since its role remains one of indicating the location (again, coronal) of the oral constriction represented by the manner element - audible friction in this case.

So the characteristic lack of dynamic behaviour and expressive power displayed by R° has the effect of setting it apart from the other members of the set to which it theoretically should belong. If the purpose of the discussion were one of justifying the presence of R° in phonological representations, then we would be forced to admit that one of its functions is merely to specify a consonantal place of articulation which has no corresponding vocalic equivalent. Alternatively, the conclusions to be drawn from the alienation of R° from the group of resonance elements may pursuade us to follow the assumptions of Avery and Rice (1989), together with others involved in the development of Underspecification models, in viewing the role of coronality as a default articulatory description which represents the absence of any active melodic components. Avery and Rice present a theory

of Underspecification resting on a system of phonological markedness, the latter determining which information should be present or absent in underlying representation. On the assumptions set out in Kean (1975) that coronal is the unmarked place of articulation, they claim that the feature [coronal] may be lexically absent in certain languages and subsequently filled in during the derivation of a fully specified phonetic form. In contrast, the presence of R° within a GP framework is deemed necessary by the model's deliberate attempts to avoid any radical forms of phonological underspecification (although the inherent underspecification of non-contrastive phonetic aspects of realization remains characteristic of the model). This is reflected in the phonetic interpretation of simplex R° as a coronal tap, this being conceivably the only remaining articulation which features a lack of all the salient properties associated with the other established elements - ie. non-open, no nasality, no labiality, no audible friction, and so on.[1] I have already made reference to the restrictive character of the framework adopted here. In particular, the postulation of a relatively small set of atomic primitives severely limits the number and nature of possible phonological processes within a system, as well as placing restrictions on the internal composition of the compound melodic expressions which may be generated via element fusion. With regard to the latter point, the presence of R° in the KLV system of representation is a necessity, since its inclusion allows the model to generate the full range of observed phonological oppositions, which it would otherwise be too weak to capture without resorting to underspecification tactics.

There is evidence, however, that the model may have the potential for over-generation as it stands. Subject to language-specific parameters, the place elements I°, U°, v° and A° are able to combine freely to yield (and simultaneously place a limit upon) the set of attested or possible compound melodic expressions. But again we must treat R° as the unnatural exception, as its amalgamation with some vocalic elements does indeed produce unlikely combinations (even for varieties of English which feature rhotacized vowels) such as (R°, U°, I°) - a vowel of the type [y] with a secondary coronal gesture. Since the problem of over-generation is something which the GP framework is specifically formulated to eradicate, then we are forced to question the status of the problematic R° element and its place within the KLV system of representation. This is, of course, in addition to the other difficulties discussed above with respect to R° and its doubtful inclusion in a set of resonance elements. In the light of these difficulties then, I propose to investigate the possibility of a representation system without a

[1]It should be noted that the cold-headedness of velars cannot similarly be seen in terms of the absence of any salient properties, since v° as a head has phonological significance only when linked to other elements which do have a salient property to contribute.

specifically defined coronal element; the discussion will take as its starting point the issue raised above - a simplex representation of [s].

3 A reanalysis of coronal obstruents

It will be recalled that there exists an apparent violation of the Complexity Condition in words such as *sweet* and *assume* which contain the problematic *s+glide* sequences discussed in §2. Specifically, for a simplex glide (either I° or U°) to govern its rhymal complement [s], the latter is required to be no more complex than its governor; our task then, is one of finding a suitable representation of [s] which is also simplex. Given the established internal composition of this melody unit as (R°, h°), together with the considerable degree of doubt that has been cast on the status of R° as a place element, I propose to direct the investigation towards a possible analysis of [s] as the phonetic interpretation of the noise element h°.

In acoustic terms the salient property of h° is given by Harris (1992) as the presence of high-frequency aperiodic energy, which translates into an articulatory definition that specifies a narrowed stricture producing turbulent airflow. This turbulence, or noise component, is recognized at two different levels of intensity by the present system of representation according to its contribution as a head or an operator. As operator it characterizes the noise component associated with the class of obstruents; and as the head of an expression, h° defines the small group of sounds characterized by their high degree of stridency - eg. [s, š] in English, which have a greater degree of friction noise than other coronal fricatives such as [θ].[2]

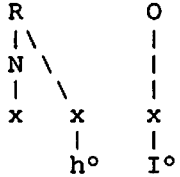
Significantly, this dual functioning of the noise element may hold the key to our reanalysis of h°. Since h° as a head effectively contributes the phonetic feature **stridency** to a compound melody unit, and the only fricatives in English which are now generally described as strident (ie. [s] and [š], together with their voiced counterparts) also contain R° in their internal representations, then we can make a direct association between stridency and the presence of coronality - whenever we find a strident fricative, we can predict that it will be a coronal articulation. On this basis it is not unreasonable to make the further assumption that the h°-headedness (ie. the stridency) of [s] and [š] necessarily incorporates coronality into its phonetic description. I propose then, that an expression with h° (rather than

[2]In this analysis it will be necessary to assume that the phonological contrast between, say, a labio-dental and a labial-velar fricative is captured not by h°-headedness but by the presence/absence of the tonal element H^{-}: hence, [f] = (H^{-}, h°, U°), [ʌʌ] = (h°, U°).

any resonance element) as its head manifests the set of formant transitions associated with coronal gesture - but without the presence of a specifically defined coronal element in the internal representation of that expression.

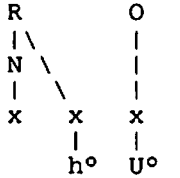
Thus in the absence of any contributing salient properties (from elements acting as operators) the expression (v°, h°) will be phonetically interpreted as [s]. In this way we achieve a phonologically fully specified melodic description of [s] which contains only one element, thus satisfying the complexity constraints on the formation of some formerly problematic *s+C* sequences. So, in place of the example in (4c) we arrive at the following well-formed rhyme/onset configurations:

(6) a.



suit [sju:t]

b.



sweet [swi:t]

The first point to be made with respect to this analysis is rather an obvious one - that the choice of representing [s] as a simplex expression forces us to view this sound as something of an exception within the class of fricatives. I shall assume that all non-strident oral fricatives in English consist of a place element fused with h° as an operator, the latter contributing audible friction to the segment. This gives us the representations [f] = (H^{-}, h°, U°), [x] = (h°, v°), and so on. In contrast, [s] as a simplex melodic expression must be treated separately; although its representation encompasses the h° friction component integral to all fricatives, its resonance properties are not derived from any lexically present melodic source, but rather from the absence of any such source in its internal composition. However, this situation seems not to be too problematic. In fact, it results in a potentially desirable state of affairs, since the theory should ideally possess some formal means of setting apart [s] from other fricatives in a way that reflects the idiosyncratic behaviour of this segment - in particular, I refer to the so-called "magic" licensing properties of [s] presented in Kaye (1992). So, given this analysis, coronal obstruents are rendered intrinsically less complex than their non-coronal counterparts, due to a lack of I°, U°, or A^{*} in their representation - the effects of which may be observed in the many phonological processes that only coronal segments undergo.

The proposed complexity differences existing between coronal obstruents and, for instance, corresponding labials and velars, are evident both in the static

phonotactic relations present in some phonological systems, and also in some dynamic processes where the relative phonological weakness of coronals is highlighted. Instances of static phenomena may be found in the constraints on the formation of CC clusters in English - both branching onsets and rhyme/onset sequences. In the case of branching onsets, the Complexity Condition yields the CC patterns shown in (7). Recall that [w, j, r] are simplex expressions in KLV 1990, and that [l] contains ?° in addition to its resonance element. The representations of [l] and [r] clearly require some revision in the light of the present argument, and will be mentioned below.

(7) [kw], [kr], [kj], [kl]
[tw], [tr], [tj], **but *[tl]**

An explanation for the fact that both [kl] and [pl] are well-formed onsets, whereas [tl] is impossible, may refer to the claim that the coronal stop contains fewer elements in its internal representation than [k] and [p], and is thus not strong enough to govern the complex lateral in the way that the labial and velar stops can. As for rhyme/onset sequences in English, it may be observed that the word-internal CC clusters in *doctor* and *chapter* are well-formed, whereas a reversal of the two segments in each case (ie. so that the coronal precedes the non-coronal) is impossible - thus, **dotker* and **chatper* contain ill-formed sequences. Similar examples are discussed in KLV 1990. Rather than making the *ad hoc* stipulation that [t] can never be a governee, we can instead rule out the presence of a coronal stop in coda position on the grounds that, being phonologically unspecified for place of articulation and occupying the governed position in a branching rhyme, [t] would necessarily adopt the place feature of its governor in the following onset to yield a geminate consonant. This possibility (and the resulting form *[čæppə]) is, of course, not supported in English.

Examples of dynamic phonological processes illustrating the relative weakness of coronal stops and fricatives are numerous: for instance, coronal assimilation (in which coronal segments assimilate to other places of articulation, but not vice-versa) can be found in many languages including Catalan, English, Korean, and Sanskrit. In Korean the following surface forms are realized. In (8a), [t] assimilates across a weak morpheme boundary to the place of articulation of the following consonant; whereas in (8b), no assimilation is possible with [p] or [k]:

(8)	a.	*pat + ko*	→ [pakko]	'to receive and'
		kotpalo	→ [kopparo]	'straight'

b.	*pap + ko*	→ [papk'o]	*[pakko]	'rice and'
	mek + po	→ [mekp'o]	*[meppo]	'greedy man'

This may be accounted for by assuming that the coronal contains no resonance element in its internal representation (and is therefore less complex than either the velar or labial stop) thus having the potential to receive melodic material while retaining its status as a governee (ie. without becoming excessively complex). The analysis is supported by the fact that no assimilation takes place when a cluster [non-coronal + coronal] is formed. In these cases I assume that the second segment has no phonologically defined coronal resonance to spread. So, for example, no assimilation process occurs in the following forms:

(9)	*ep + da*	→	[epta]	*[etta]	'to bear on the back'
	mak + da	→	[makta]	*[makka]	'stop' (decl.)

Given the proposals presented earlier in this section, the question arises as to whether a representation of [s] with fewer elements than other fricatives has any implications for markedness. That is, does this render [s] in some sense more phonologically basic than other fricatives? Intuitively it does, and furthermore there is ample statistical evidence which indicates the 'primary' status of [s] as an obstruent. For example, Lass (1984; 151) claims [s] to be the most unmarked obstruent, and if a system has only one fricative it is more than likely to be coronal - eg. Klamath has sixteen stops and [s]. On the basis of more detailed statistical research, Maddieson (1984) claims that 88.5% of languages containing fricative sounds have a voiceless dental/alveolar [s] (only 7% of the systems in his survey have no fricatives at all), thus rendering the coronal by far the most common fricative across the world's languages.

Besides English phonotactic constraints and examples of coronal assimilation, further evidence for the analysis of the sound [s] as simplex h° may be observed in some of the phonological processes described by Hawkins (1984; 122). He notes that there is a remarkable historical tendency for oral fricatives, and particularly [s], to change into [h]. In the Polynesian languages for example, an older Proto-Polynesian [s] has been replaced by [h] in descendant languages such as Maori. And the Indo-European [s] preserved by Latin shows a direct correspondence with the [h] of Ancient Greek, as illustrated in these cognates:

(10)	**Latin**	**Anc. Gk.**	(Mod. Greek)
	sex	*hex*	
	septem	*hepta*	*(efta)*
	super	*hyper*	*(iper)*

Many synchronic processes also demonstrate the same tendency, as observed in dialects of Spanish (eg. as spoken in Cuba, Dominican Republic) which have an [h] realization of an underlying coronal fricative in some contexts: *esperar* [ehperar], *los chicos* [loh cikoh].

All these can in fact be analysed as illustrations of the same basic phenomenon of segmental weakening or decomposition. In Spanish, the realization of a coronal as [h] occurs in typically weak environments, such as word-finally and in rhymal position, where only a restricted amount of melodic material can be or need be licensed; and with respect to the historical examples, they follow the common pattern of lenition observed time after time in the study of sound change. So we can assume that these phonological processes involving [s] amount to some kind of segmental decomposition, which is typically handled within GP by positing the loss or delinking of melodic material from the internal structure of segments. With respect to other oral fricatives which may undergo weakening (eg. [f] -> [h]), we can assume elemental loss to be more extensive in these cases, with the delinking of both resonance and laryngeal elements. However, there are two immediate problems which arise from this analysis:

(i) Given that h° in isolation now constitutes the phonological representation of [s], how do we choose to represent a glottal fricative [h] and capture the apparent systemic relatedness between [s] (together with other oral fricatives) and [h]?

(ii) If the observed [s] → [h] processes all involve decomposition, how can melodic material be lost from a simplex expression to leave a segment that is still phonetically interpretable?

Without satisfactory solutions to these problems, the proposed reanalysis of [s] cannot be justified. A further difficulty arises when attempting to characterize another lenition process whereby [s] is realised as [r] in the weakening context of intervocalic position; eg. PIE **esō* -> Latin *erō* 'will be'. Here, the problem in (ii) above is reiterated, since some melodic material must be lost from the simplex expression h° to leave something interpretable as [r]. Furthermore, the scope of the problem is augmented in that the phonological representation (v°, h°) must presumably undergo two different processes of compositional change (ie. it must lose different elements) according to whether the remaining material is interpreted as [h] or [r]. Therefore, in order to establish an argument for the analysis of [s] as simplex h° we must first address the immediate problem of finding ways to represent [h] and [r] which will capture their 'inclusion' in the phonological composition of a coronal fricative.

4 The effect of R° loss on other segments

4.1 The representation of [h]

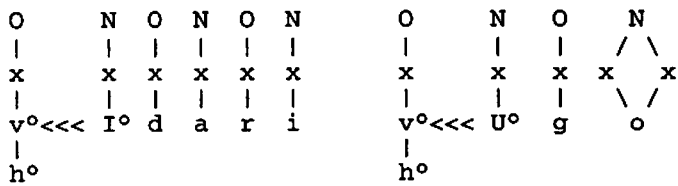
The advantages in capturing the phonological relatedness between [s] and [h] have already been emphasized; and this, together with earlier comments highlighting the importance of the dual-functionality of elements (stemming from the asymmetrical head/operator relationship), has given us a good insight into a possible representation of [h] using the original noise element h°. In the standard literature, both phonetic and phonological treatments of [h] have generally analysed the segment as one which does not fit comfortably into any of the major classes of sounds. Although traditionally described as a glottal fricative, this label amounts to something of an abstraction for two reasons. First, the amount of local friction present in [h] is minimal in comparison with that which characterizes the production of the other (oral) fricatives. Instead, only a small amount of generalized cavity friction is discernible, due to the flow of air passing through a relatively open vocal tract. Second, the label implies the presence of exclusively 'glottal' resonance (on a par with, say, labial or palatal resonance) - which is now viewed as something of a misconception. On the contrary, it seems that, if anything, 'glottal' indicates a lack of any lexically defined resonance property, to which is added some or all of the articulatory features of the following segment. O'Connor (1978) describes *h*-sounds as "strong voiceless versions of a following vowel" (1978: 143).

In many languages including English the segment [h] has a notably restricted distribution. Specifically, it can be licensed only when in foot-initial position, and only by a non-empty nucleus; that is, it must be followed by a vowel.[3] And a similar distribution can be witnessed in Japanese, where [h] also occurs only before a vowel. A further feature of the Japanese *h*-sound is that in most cases the fricative copies some or all of the characteristics of that vowel which, in terms of the Government framework adopted here, must be described as a composition process involving the spreading of one or more elements from one position to an adjacent one. Typically, an underlying fricative which is not specified for place of articulation adopts the resonance features of the following vowel: eg. the nouns *hidari* 'left' and *hugoo* 'millionaire' are realized as [çidari] and [Φugo:] respectively, the initial syllable onsets of these words having gained I° and U° respectively from the following vowel to be realized phonetically as a palatal fricative and a labial fricative.

[3]Some British English dialects such as Scouse appear to relax the latter condition when [h] results from segmental decomposition.

As for the remaining components in the representation of these underlying [h] sounds, we require the presence of one or more elements which will have the effect of transforming an I° or U° glide into its corresponding fricative. I suggest that we need look no further than the element h° which features high-frequency aperiodic energy as its salient property, contributing a noise component to (amongst other groups of segments) the class of fricatives. The melodic material of the two example words is therefore arranged as in (11), with <<< indicating spreading:

(11)



Thus I propose that, in isolation, a glottal fricative [h] without any superimposed oral articulation may be represented as cold-headed (h°, v°) - ie. the head of the melody unit is occupied by the cold element. Then whenever the segment anticipates the vocalic features associated with the following nucleus, those features spread to the vacant head of the fricative, as illustrated above.

There are, however, two caveats which must be considered with respect to this analysis of [h] - one concerning the dual function of v° and the other concerning the process of decomposition. Although the v° at the head of the expression (h°, v°) here indicates the absence of melodic material, the same cold element v° can also actively contribute the feature velarity to segments occupying non-nuclear positions. So the underlying (h°, v°) of *hidari* and *hugoo* would be expected to be interpreted as a velar approximant coupled with oral friction - that is, a velar fricative [x]. The observation that [h] is never realized as [x] in Japanese and only rarely so in English is rather less important than the nature of the phonological distribution of these sounds throughout the world's languages. Specifically, in order for this analysis of [h] to remain a valid one, there must be no language which displays a phonological opposition between a glottal and a velar fricative.

There are several systems which appear to suggest the presence of such an opposition, including Irish and Sotho. The latter, for example, shows an apparent minimal pair *hona-xona*, yet it seems prudent to investigate the possibility that the segment transcribed as [x] may be better described in terms of an affricate segment [kx]. A more serious threat to the validity of the claim that [h] and [x] share the same underlying representation (h°, v°) may well exist in the lenited forms of [s]

and [k] in Irish, which weaken to [h] and [x] respectively in the appropriate contexts. In order to maintain phonological contrast in these environments we might posit a representational difference such as the one suggested in (12), in which the tonal element present in the stop consonant is retained in lenited form:

(12) [s] → [h] (where [h] = (h°, v°)
[k] → [x] (where [x] = (H^-, h°, v°)

An analysis along these lines would also be useful in capturing the fact that the (apparently) more complex [x] is able to govern sonorant consonants (eg. liquids) in some languages, whereas the weaker [h] is never required to be a governor. However, such speculation merely indicates the need for more detailed investigation, and I shall leave the matter open.

The second proviso concerns the process of segmental decomposition and the mechanism of element loss by which it typically takes place. As mentioned earlier, a potential problem for the analysis of [s] as a simplex h° lies in its apparent lenition (via element loss) to a 'weaker' segment which is still phonetically interpretable. Clearly the process that weakens [s] to [h] does not involve the actual delinking of any melodic material, since the same element is used to represent both sounds. Instead, what we must accept is that the relegation of h° from head position to that of operator during the [s] → [h] process still constitutes a form of segmental weakening - that is, the analysis indirectly predicts that an expression (v°, h°) will require greater a-licensing power than (h°, v°) in order to be licensed.

Intuitively, the process which downgrades the status of an element (rather than delinking it altogether) may still be characterized as a weakening change, as there is indeed a loss of non-salient features (ie. coronal in this case) that are manifest only by virtue of the element's status as a head. This relegation to operator position is readily seen in the 'reduction' of the vowel [a] (v°, A^+) to [ə] (A^+, v°) in unstressed positions - which clearly amounts to a case of segmental weakening.

4.2 The representation of *r*-sounds

Two lenition processes that may be observed in a number of English dialects are standardly referred to as **glottalling** and **flapping** (or tapping). The latter process, discussed in detail in Harris & Kaye (1990), involves the lenition of a coronal stop in the weakening environment of intervocalic position to yield a tap; and the phenomenon was elegantly explained as the loss of all melodic material save the

place element R°, taken to be phonetically interpretable in isolation as a coronal tap. Clearly, this analysis must undergo some revision if we wish to retain the notion of an element inventory that does not include the specifically defined coronal element R°. Yet this may not be such an insurmountable problem if the process by which lenition takes place in GP is itself allowed to do the work of predicting a suitable representation of [D].

The challenge is evidently one of finding two independent lenition trajectories which both take the simplex expression (v°, h°) as their pre-deletion points - one yielding a segment interpretable as [h] and the other as [D], but both involving some form of internal segmental simplification. The first of these has already been considered, and I have made the claim that the derivation of [h] from [s] involves a reinterpretation of h° as an operator rather than a head. With respect to the nature of the second weakening phenomenon, there appears to be little alternative: having transposed the only two elements at our disposal to arrive at the expression (h°, v°), there remains just one further step in the direction of segmental decomplexification - the loss of h° altogether.

The absence of any melodic material (here, a result of the delinking of h°) is indicated by the presence of the cold element v°, which lacks any salient property. Aside from its contribution of velarity to consonants, this element functions primarily as a default value for nuclear positions that are regarded as 'empty' in terms of their melodic content. Whenever the strictly defined conditions of proper government fail to be met, a so-called empty position may manifest some language-specific vowel quality which is characteristically non-contrastive within its own phonological system (see Charette 1991). However, if an empty nuclear skeletal slot *is* licensed by proper government, then the nucleus receives no phonetic interpretation. Although the licensing of v° in isolation has typically been restricted to nuclear positions, I see no reason why this should necessarily be so.

The phonology literature has traditionally used the quasi-phonemic representation /r/ for what I shall loosely refer to as the group of *r*-sounds. But unlike the majority of other phonological units, which specify to a large extent the articulatory properties associated with typical realizations of those abstract units, the segment /r/ is used to represent a somewhat heterogeneous class of sounds that includes taps, frictionless continuants, uvular fricatives, and apical trills; the resulting situation is one in which the size of this class of rhotic sounds fails to be reflected in its distinctive potential. If we choose to represent these different system-specific realizations of /r/ with an internal structure which reflects their articulatory characteristics, then the result would be a range of widely differing segmental representations which fails to capture both the attested sound correspondences across related languages (eg. cognates) and the phonological properties common to the class of *r*-sounds - properties such as their severely

restricted distribution within syllables and their idiosyncratic behaviour with respect to the governor/governee relationship.

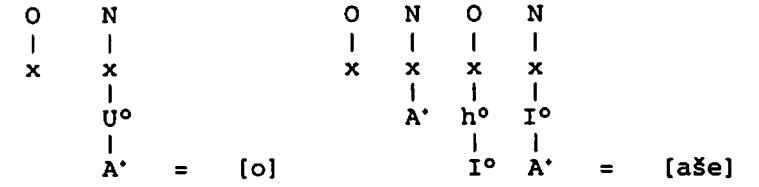
Instead, my proposal is one which takes a number of *r*-sounds to be the language-specific phonetic interpretations of an empty non-nuclear position. So, in the same way that v° in a nucleus has a number of different phonetic values (eg. open schwa in Catalan, [ɨ] in Moroccan Arabic and Japanese), the cold element in isolation demonstrates a similar diversity in non-nuclear skeletal slots: for example, trills, taps, approximants and fricatives are all commonly found, both coronal and uvular. Languages which have a contrast between two different types of *r*-sound (eg. tapped vs. trilled coronal *r* in Spanish) do not necessarily pose a problem for this analysis. A possible solution may assume that only one of the sounds (say, the tap in Spanish) amounts to the interpretation of an empty non-nuclear position, while the other (the trill) may be more suitably analysed as a more complex segment (which perhaps contains the noise element h°, for example).

My proposal is that v° may be interpreted as either a neutral vowel or an *r*-sound, depending on its syllabic position. And it seems that the analysis of *r* as the ultimately simplex segment (ie. it contains no melodic material and thus demonstrates zero complexity) may shed some light on one aspect of this segment's distribution in English and other languages. Referring back to the possible word-initial CC clusters tabulated in (1), it will be noticed that *r* never assumes the role of a governor: that is, a branching onset of the form *rC* is deemed impossible in English (and most likely, universally). Given the representation of *r* as v°, this phenomenon need no longer be treated as arbitrary but can now be explained simply in terms of compliance with the Complexity Condition. Specifically, if a segment can only govern another segment which is of equal or less complexity than itself, then even the sequences [rj] and [rw] must be ruled out as possible branching onsets on the basis that the glides contain a single element in their internal structure (and therefore conditions for government fail to be met).

A further argument in support of the claim that *r* amounts to a realization of the cold element comes from a process to be found in Haitian French Creole, described by Tinelli (1981; p. 174). In present-day Standard French the sound [h] is no longer realized. However, the historical presence of the fricative is still reflected in the orthography of some French words: therefore *haut* [o], *hacher* [aše]. A subset of these orthographically *h*-initial words form the so-called *h-aspiré* group, which are significant from a phonological point of view, since their behaviour with respect to elision resembles that of consonant-initial morphemes, despite their phonetic properties. To account for the facts, GP has adopted an analysis first presented in Clements & Keyser (1983), who proposed that a word-initial empty onset position blocks elision by preventing two nuclei from

being adjacent at the skeletal level. The following structures for these example words are based on this notion of empty onsets:

(13)



I shall make the claim that the notion of the licensing of empty nuclei via proper government (PG) may be extended to the licensing of empty positions in general. Following the assumption that the application of PG licensing is controlled parametrically, I shall assume that the use of PG in the licensing of non-nuclear positions is also subject to parametric variation. With respect to different systems, this will result in either the obligatory interpretation or non-interpretation of such positions. Since, in Standard French, these empty positions are licensed to remain empty, we must assume that this is achieved through PG; that is, the parameter allowing the proper government of non-nuclear slots is set to apply.

In contrast, it appears that Haitian French Creole (HFC) does not license empty onset positions, with the result that the 'empty' slots in (13) must have phonetic content. From this generalization about HFC it is possible to make the claim that proper government of non-nuclear slots is not operative in this system (ie. the relevant parameter is set in the OFF position); and if these positions cannot be licensed (via PG) to remain empty then they must be interpreted. Given the above proposals concerning the interpretation of v° in empty non-nuclear positions, we can predict that some kind of *r*-sound will be realized in word-initial position - which is precisely what does occur. In this Creole system, *r* is realised in the empty onset positions of almost all *h-aspiré* words, resulting in the following pronunciations:

(14)

[raše]	*hacher*
[rele]	*héler*
[ro]	*haut*
[raji]	*haïr*

The presence of *r* in these cases cannot be explained by the spreading of particular melodic material from the following nucleus, since examples can be found to precede the full set of vowels. Instead, the facts may be accounted for by

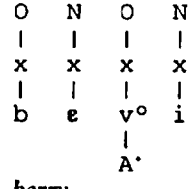
recognizing the HFC realization of *r* as a system-specific interpretation of v° in a non-nuclear position (since the system cannot license the onset to remain empty).

So, HFC may be directly compared with Standard French in terms of their respective realizations of the *h-aspiré* words. In the former (parameter setting OFF) the proper government of empty onsets fails to operate and thus the unlicensed v° is interpreted as *r*; in the latter, however, the same parameter is set in the ON position to allow empty non-nuclear slots to be licensed, and hence, remain phonetically empty.

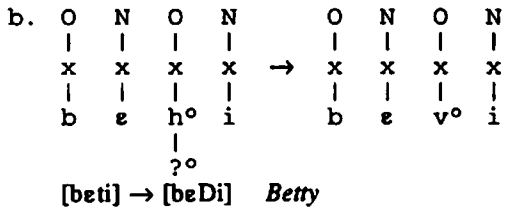
It appears, however, that the notion of unlicensed non-nuclear v° encounters some difficulties with respect to data from English. In particular, I refer to the apparent contrast between two types of *r*-sound that exists in those systems featuring the decomposition phenomenon of *t*-flapping. A phonological contrast (eg. in some varieties of Irish English and most US dialects) may be observed between an approximant sound in *berry* and *carry* and a coronal tap in, for example, *Betty* and *catty*. The tap, of course, results from the lenition of [t] in a weakening environment, and has already been analysed above in terms of the suppression of all melodic material to leave an empty (though phonetically interpreted) position. But given the existence of minimal pairs such as *carry-catty* in some systems, we are forced to assign a different melodic structure to the approximant sound, in the same way that an underlying phonological distinction was required in the description of the two contrasting *r*-sounds in Spanish.

The exact nature of the representation of English approximant *r* is in no way central to the re-analysis arguments proposed above, and consequently I shall avoid any in-depth discussion of this issue. Instead, I suggest that it seems prudent to consider initially the A^{+}-glide analysis proposed in Broadbent 1991 (originally for the description of linking/intrusive *r* in English), since her claims regarding the phonological identification of English *r*-sounds are largely well supported in themselves, and also because they make no reference to the disfavoured coronal element R°. With the A^{+}-glide possibility in mind, the phonological distinction observed in the word pair *berry-Betty* is indicated in the following structures (only the relevant segments show internal composition):

(15) a.



berry



I shall assume that, in those English systems demonstrating tapping in weak environments, the licensing of these empty positions is prevented from taking place - that is, the parameter controlling the proper government of such positions is OFF. This assumption is based on the generalization that intervocalic slots in English are always phonetically interpreted, either as 'full' (underived) consonants, weakened consonants, as glides, or as one of several lenition target sounds such as [?], [h], [D]. Silence (that is, a licensed empty position) is not a possible alternative in these instances.

It seems that there are several advantages in distinguishing between two different *r*-sound types in some varieties of English. Not only is it possible to capture the phonological opposition illustrated in (14), but we also preserve two important claims concerning English *r*, each requiring different phonological descriptions of the relevant sounds. Firstly, by viewing [D] as one product of coronal obstruent lenition we retain the 'standard' GP decomposition analysis of *t*-flapping without treating the phonologically unspecified coronal segments as special cases; and secondly, by representing the English approximant *r*-sound as the cold-headed expression (A^{+}, v°), we do not discredit the proposals made by Broadbent (1991) with respect to her analysis of linking/intrusive *r* in terms of A^{+}-glide formation.

5 Conclusion

In the interests of developing an ever more constrained phonological model in which the capacity for over-generation is minimised, I have taken the step of attempting to reduce the size of the element inventory - in this case, by considering the feasibility of a representation system which avoids any explicit reference to **coronality** as a significant phonological entity. The absence of R° from the internal structure of coronal articulations carries with it a number of theoretical implications which appear to be supported by observable phonological events. The proposals outlined in this paper have the effect of rendering coronal obstruents inherently less complex than their non-coronal counterparts. And this situation is

reflected in the intrinsically weak character of these segments, as witnessed in their susceptibility to decomposition and in their tendency to undergo assimilation. This analysis also solves a formerly problematic issue regarding the apparent violation of complexity conditions encountered in the *s+C* sequences of English and other languages.

I have claimed that the loss of R° leaves the noise element h° interpretable in isolation as a coronal fricative; potential contrasts within the range of coronal articulations, such as the opposition between [s] and [Θ], may be captured by incorporating a tonal element such as H⁻ into the representation of the phonologically stronger segment (ie. [θ], a potential governor). Given the strong interrelationship that exists between [s] and [h], as witnessed in the common process of lenition whereby the former loses its oral resonance, I have proposed that both sounds be represented using the same element h°, their only difference lying in the asymmetrical head/operator relationship. So, while the full-headed expression (v°, h°) indicates unmarked oral friction in the form of [s], the cold-headed configuration (h°, v°) may be taken to represent a basic fricative sound without any oral resonance - that is, [h].

The only other group of segments considered in this analysis has been referred to as the class of *r*-sounds. I have proposed that some members of this diverse group may be represented by an empty non-nuclear position, which is phonetically interpreted in a language-specific way whenever it remains unlicensed. In systems where a contrast exists between two or more different *r*-sounds, such as in Spanish or English, clearly these segments must be distinguished phonologically; I have suggested that the coronal tap (a potential pre-deletion target) should perhaps be treated as the interpretation of non-nuclear v° in both cases, while the contrasting sound can be described in a way which reflects its acoustic properties (in terms of friction or sonority, for example).

I readily acknowledge the fact that the material discussed in this study is neither comprehensive nor conclusive. With respect to the representation of *r*-sounds, I have made no reference to the group of retroflex articulations which must somehow be incorporated into this amended model. In addition, we are faced with the task of developing an account of the mechanisms whereby empty positions become licensed, in order to successfully handle the post-vocalic *r*-sound of rhotic varieties of English. More generally, the discussion has concentrated largely on the internal representation of obstruents, while a number of coronal sonorants, such as [n] and the group of lateral sounds, remain as yet unanalysed. With respect to the coronal nasal, it seems prudent to pursue a parallel analysis which recognizes [n] as the most basic, unmarked nasal segment by virtue of its lack of a resonance element. However, this amounts to little more than speculation and, together with

many of the other suggestions made in this paper, merely offers an indication of the direction in which further research may be undertaken in the future.

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