Contour segments without subsegmental structures*

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In a variety of segments,[1] one or more phonological elements is realised/interpreted[2] phonetically later than the rest. Such segments are traditionally termed "contour segments". In this paper I propose that the element(s) that are realised late (termed "lazy" elements) are in fact late additions to normal, single positions of a GP representation, and their late realisation is due to their not being lexically attached to the skeletal point in question. In other words, contour segments universally involve either a floating element or an element acquired from elsewhere in the phonological representation by the standard licensing mechanisms.

1. Preliminaries 1: The problem and the story so far

1.1. Affricates and other contour segments: A perennial problem of phonology

There are several types of segment which consist of two (perhaps even three)[3] phonetic parts (i.e. distinct articulatory and acoustic patterns), but which behave phonologically (e.g. within syllable structure) like a single segment. The phonetic parts of such segments are usually (always ?) patterns which occur in

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[1] A segment is here taken to be a *skeletal point* together with a *melodic expression* consisting of all phonological elements that are realised phonetically at that point. *Skeletal point* and *melodic expression* are well established parts of the theory of Government Phonology; recall that every non-empty melodic expression has a unique head and optionally any number of operators (up to the maximum of the full set of phonological elements).

[2] Throughout this paper, the term "(phonetically) realised" should be taken to mean "(phonetically) realised or interpreted".

[3] In Kaingáng, a Brazilian language described by Kindell (1972) in Wiesemann (1972), there is strong evidence for the existence of "medio-nasals" ([^{b}m^{b}] etc.), which alternate with prenasalised ([^{m}b] etc.), postnasalised ([b^{m}] etc.), and full nasal ([m.] etc.) stops depending on the nasality / orality of the preceding / following vowel. It seems that an analysis in line with the proposals of this paper is feasible.

other segments as their sole realisation. Thus, for example, the German affricate[4] [p^{f}] consists of the phonetic patterns of i. a bilabial stop and ii. a labiodental fricative. Pattern i. is also the phonetic realisation of the segment [p] and pattern ii. that of the segment [f]. All three segments [p^{f}], [p] and [f] are phonologically distinct in German.

Other segments of this type are consonants such as [^{m}b] (prenasalised), [b^{w}] (labiovelarised), [b^{j}] (palatalised) and vowels such as [^{u}a, ^{i}a, a^{u}, a^{i}] (collectively known as short diphthongs). There are many more such segments, and I will not attempt a descriptive summary of them all. Rather, the analysis outlined below predicts that the number of contour segments is potentially very large.

The last innovative theoretical analysis in feature-based phonology (Sagey 1982) has been generally accepted by subsequent supporters of feature geometry. There, basically, two feature-trees are associated to the same skeletal position, and ink is saved by repeating only the changed feature(s) or node(s) in the second tree, or by collapsing the two trees into one which contains an ordered sequence of features. Moreover, the features themselves can be re-defined or regrouped in such a way that only a single node of a feature-tree changes its value in a contour segment. While there is little to say about the analysis of contour segments in itself (after all, it can always produce the correct phonetic outputs), the framework of feature geometry in which it is couched has turned out to be devoid of any explanatory power because it overgenerates wildly. That theory could easily accommodate, say, a segment such as [f^{p}] (i.e. the reverse order of the two phonetic parts of an affricate) – a segment which does not exist in any language. Any constraints that are imposed on the ordering of the parts of, say, affricates are purely ad hoc stipulations.

In element-based phonology there have only been unsatisfactory solutions so far. Kaye, Lowenstamm and Vergnaud (1985:324) simply have two elements attached simultaneously to a single skeletal point and do not mention why their phonetic realisation is not simultaneous, though they imply that it has to do with headedness.[5] This contradicts the nature of elements: if an element is attached to a skeletal point (no matter by what licensing mechanism) then it is

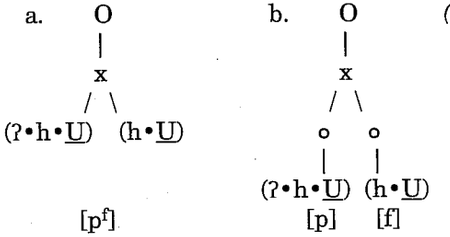
[4] The transcriptions used here are more or less what is generally found in the literature. The superscript notation is *not* intended to imply that I consider that part of the contour segment to be secondary in any way. On the other hand, using superscripts is a good way to indicate that a single segment is involved, without resorting to ugly tie bars.

The transcription of diphthongs is also not a crucial issue to me: on the contrary, given the analysis of contour segments that I outline below, we will expect variations in timing which produce effects of (apparent) mutual assimilation and even fusion, as in Austrian German [a^{u}] (hypercorrect) as in [la^{u}tɐ] 'sheer' via [ɑ^{o}] and [ɒ^{o}] to the monophthong [ɔ].

[5] "In Kpokolo, as in many other languages, there exists a labialised velar series of consonants, [kw], [gw] and [ŋw]. (...) [T]hey can be considered to consist of a K element, representing velar articulation, and U–, with the former being the head of the segment." (Kaye, Lowenstamm and Vergnaud, 1985:324). Kpokolo also has true labiovelars such as [k^{p}], as in the name of the language itself.

realised at that point. Thus a putative traditional GP representation such as (1a) can only be interpreted as a stop [p], rather than the intended affricate [p^{f}], because the stop element [ʔ] is associated with the (one-and-only, indivisible) skeletal point. Moreover, the second bundle of elements is completely superfluous, since both elements are contained in the first bundle.

(1) a. b. *(The rightmost element is head)*



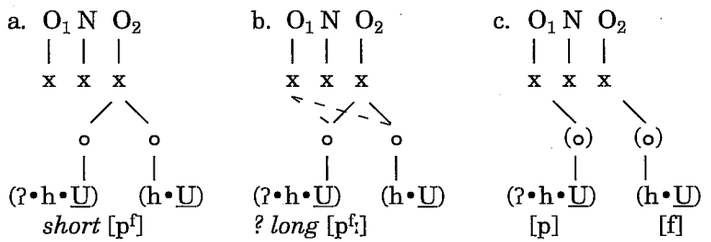
What seems to be needed to save this representation is something approximating a "bundles of elements", i.e. two subsegmental structural positions that are daughters of the skeletal point, represented with a dot "o" in (1b). Such subsegmental positions are considered by some to be equivalent to the "root nodes" of feature geometry. However, neither subsegmental positions nor root nodes are generally accepted parts of current GP[6] and should not, in my opinion, be incorporated. Adding such devices would immediately allow for massive overgeneration, including the unwanted *[f^{p}]. Moreover, yet another additional mechanism would be necessary to spread such subsegmental nodes across an empty-position sandwich (ONO or NON, where the middle constituent is empty), as shown in (2) for the long/voiceless affricates of many varieties of Austrian German, as in [kep^{f}ː] 'head, pl.' (Standard German *Köpfe*). Since this long affricate alternates with its short counterpart by a process traditionally termed *isochrony*[7] (cf. the singular form [koːp^{f}] 'head'), we must assume that the affricate melody is transmitted from a single onset to a preceding empty onset across the intervening empty Nucleus. However, it is not at all clear how this can be done. If *both* subsegmental dots of O_2 in (2a) are attached to O_1 (shown in (2b)), we get a line-crossings violation. If only the first dot is attached, shown in (2c), we get dangling dots which are now superfluous (indicated by parenthesis in (2c)). In fact, here the representation of (1a) offers a better alternative – reattachment of the

[6] On the possible use of root nodes, see the work of John Harris, e.g. 1994.

[7] In many phonetically monosyllabic nouns the singular has a long vowel and short/lenis final vowel (CVːC) and the plural has a short vowel and long/fortis final consonant (CVCː). In all cases, the melody is identical in singular and plural; only the length varies. Alongside such alternating words (which I assume to have the lexical structure CVONCN, where C is a lexically filled onset, V a lexically filled vowel, O an empty onset and N an empty nucleus), there exist some nouns with a lexical long vowel (i.e. CVːC in singular and plural), e.g. [t^{s}uːg], pl. [t^{s}iːg]. For these I assume the lexical structure CVO**V**CN, where the second (bold) nucleus is filled. For details of the facts, see Rennison (1981) and for a GP analysis, see Kühnhammer (in press).

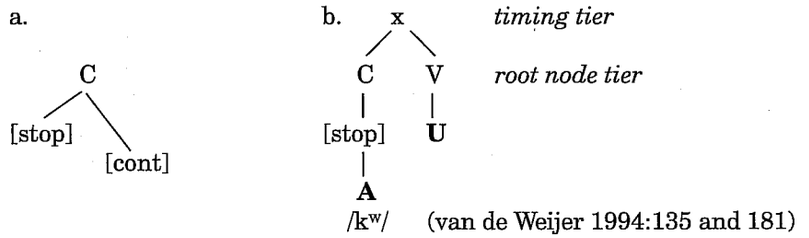
first melodic expression to O_1. But since (1a) does not adequately represent short [p^f], this alternative is not available.

(2)



A third, more recent approach to contour segments is that of van de Weijer (1994), which involves a fusion of GP-like elements (in particular, I,U,A) and feature-geometry-like trees with root, place and manner nodes. He proposes an analysis of affricates as a single root node (C in (3a) below) with two "unordered" monovalent daughter nodes [stop] and [cont] (≈fricative), as shown in (3a), and a two-root analysis of labialised consonants (and other contour segments), as in (3b).

(3)



(van de Weijer 1994:135 and 181)

Here again, the potential of these mechanisms for overgeneration is very high because van de Weijer's approach, although restrictive in comparison with previous feature geometry models, does not propose any principled restrictions on the combination or interpretation of the formal devices used. Thus, although the stop-fricative ordering within affricates is formally accounted for in (3a) by means of unordered nodes [stop] and [cont], of which the [stop] node is higher in the tree, there is no general principle of feature geometry which demands this (or, conversely, forbids the opposite hierarchical ranking).

The shortcoming of all analyses involving (collapsed) double tree representations is that the ordering of the two (branches of) trees can only be stipulated; nothing in the theory forces the first part to come first and the second to come second.

2. Preliminaries 2: Learning from history

2.1. Do we really want a "separate" solution for contour segments

It may be possible to analyse affricates like German [p^f] as funny pronunciations of aspirated voiceless stops (i.e. in GP terms, a stop with a high-tone element H). For German, and perhaps other languages with affricates, this solution is viable because there is only a two-way voicing contrast among the other stops (analysable as low-tone (L) for voiced and no tone for voiceless). But this solution will not work for languages like Sesotho, which has the stops [t, t^h, t^s, d] plus [t^l], [t^{lh}] (John Harris, p.c.).[8] And even if analogous solutions were possible for certain contour segments, they would still be inadequate in two important respects: i. they do not account for the ordering of the phonetic parts of the contour segment, and ii. they leave open the question of the interpretation of floating elements (given that they are predicted to exist by the theory).[9]

2.2. The solution has to be simple

There is little sense in adding any device to GP which increases its generative power; the solution we seek should rather involve maximal use of existing theoretical devices. By taking this route we will hopefully find that contour segments can be related in some unexpected way to previously analysed phenomena – here, specifically, we will see that they in fact relate to other floating elements in an interesting way. There are two classes of floating elements (i.e. elements which are introduced into the representation at a position to which they are not lexically attached):[10] one class can dock on to some other position (e.g. floating tone elements, (I) in German umlaut, but the other is doomed to finally attach to the position at which it was introduced (because it cannot be licensed anywhere else). I see no reason why any phonological element should be excluded from either of these classes – which means that a large number of elements that were previously considered to be lexically attached in fact belong to this second class.

[8] My representations for these stops according to the approach outlined below are: [t] = O(R•_), [t^h] = O(H•R•_) or O((H)•R•_), [t^s] = O(R•(_)•_), [d] = O(L•R•_), [t^l] = O(R•(_)•[_]•(R)), [t^{lh}] = O(R•H•(_)•[_]•(R)) or O(R•(H)•(_)•[_]•(R)).

[9] I assume without further debate that floating tones are uncontroversial, and that given the equality of all elements, every element should potentially be able to float. Given this assumption, a natural question is: Where are the (other) floating elements? And how do they manifest themselves?

[10] More precisely, "at a position" should read "at or near a position or series of positions". I do not wish to imply that elements can be "semi-attached" or "potentially attached" to some particular skeletal point. Rather, floating elements have a linear position on a particular tier and may be realised (if licensed to do so) at a landing site anywhere between the skeletal points to which the neighbouring elements on that tier are attached. See 4 below for further elaboration.

Obviously, unless there is any reason for the "doomed" class of floating elements to remain floating, they will tend to be analysed as lexically attached by children acquiring phonology, and thus some contour segments will evolve to become a simplex segment containing all the elements of the former contour segment (i.e. [pᶠ] > [f], but never [pᶠ] > [p]).

3. The approach

3.1. Contour segments arise when an element is realised late

It might seem to be the case that contour segments normally involve the late phonetic realisation of a single element of their melody. I see no a priori reason why the number of late elements should be restricted to one, even though the systematic absence of certain segment types, like [pᵛ], an affricate with late (h) and (L),[11] or light diphthongs such as [aᵠ] (with late (I) and (U) elements), superficially points in this direction.[12] On the other hand, labio-palatalised consonants (with late (I) and (U)) exist quite widely, e.g. in Twi, an Akan language of West Africa, in the name of the language itself: [tᶣi]. Also, we should be wary of equating putative phonetic objects such as [pᵛ] or [aᵠ] with well-formed phonological representations; [p] with late (h) and (L) operators may have some completely different phonetic realisation, as may [a] with late (I) and (U).

In any case, the relationship between the two parts of a contour segment is not only close; it is normally[13] one of inclusion, as stated in (4) and (5).

[11] Here and elsewhere in this paper I use the traditional noise element (h) for readability. In fact, I assume that it is an empty operator (see Rennison in press a). A full list of the elements I assume is given in footnote 16.

[12] At least two explanations for this state of affairs spring to mind: i. the restriction on the number of elements that are realised late to just one may be akin to the restriction (also to one) of the number of tones involved in the rightward tone shift of Mòoré and other Gur languages (triggered by a floating tone). It seems that our cognitive system will not allow the displacement of very much melodic material to the right of the position of its lexical origin (presumably because this would make parsing difficult), although multiple realisation of melody abounds (in assimilation processes); or ii. there is no real restriction, but since the late realisation of elements is marked (and potentially a hindrance to parsing), the co-occurrence of two or more such elements is not to be expected. And, of course, i. may just be one correlate of this markedness. A third possibility is, of course, that elements are realised in such a way that the increase in complexity is minimised, e.g. [aᵠ] is realised as [ɔᵠ] (as in German – cf. Rennison 1989), effectively reducing the number of late *realisations* of elements to one, even though more than one is "lazy" in the sense outlined below.

[13] See the discussion of (8) below for the case of head "replacement", which is the only violation of this inclusion relationship.

(4) *A contour segment /σ/ at skeletal point χ has a single melodic expression, comprising*
   a. *one or more elements that are lexically attached to χ and*
   b. *at least one element that is not lexically attached to χ, but which is licensed to be realised at χ.*

(5)
   a. *The first phonetic part of a contour segment /σ/ at skeletal point χ is the realisation of all and only the phonological elements which are lexically associated with χ.*
   b. *The second phonetic part of a contour segment /σ/ at skeletal point χ is the realisation of all the phonological elements which are associated with χ lexically* ***or otherwise.***

Note that (5) states constraints on contour segments *if* they happen to occur. It makes no claim that a contour segment *must* occur in any particular case. In other words, non-lexical melodic material may be realised throughout the whole segment, in which case no phonetic contour arises (cf. the end of 3.2. below).

The definition of contour segments in (4) and (5) involves a radical reanalysis of traditional views. The lexically attached melody of a skeletal point is never sufficient to produce a contour segment on its own. Either the melody must include a floating element, or an element must be acquired from elsewhere in the phonological context (by whatever licensing mechanisms are operative).

Let us first consider cases where a single element is realised late. For brevity, such elements will be referred to as "lazy", as a cover term for all elements which are added (phonetically) in the second part of a contour segment – either floating or acquired from elsewhere in the representation.[14]

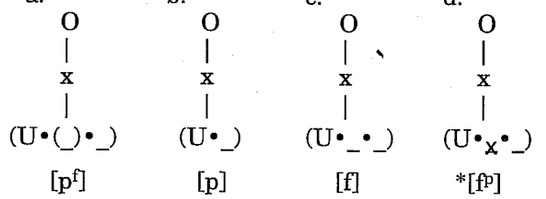
1.1.1. Onsets with lazy elements: some basics

As stated in (5), the lazy element which is added to the melody of the skeletal point is realised only in the second phonetic part of the segment.

Let us first consider the fairly simple case of German [pᶠ], shown in (6a) (where the late element is shown in parentheses). The representations of the [p] and [f] as single segments are given in (6b) and (6c) respectively for comparison.

[14] By grouping these two types of occurrence of elements under one label I do not wish to imply that they are similar in any other respect. However, I do believe that their behaviour with respect to the late realisation is identical: i.e. a floating element E and an acquired element E, when attached to the same melodic expression, will always produce the same phonetic effect.

(6)



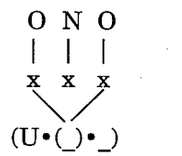
(The rightmost element is head)

(x *denotes* *"late erasure")*

These representations assume a non-standard analysis of fricatives (arrived at for independent reasons on the basis of markedness),[15] namely that they contain both a stop and a noise component (i.e. the empty head and empty operator of Rennison in press a).[16] Note, quite crucially, that the reverse order of the phonetic parts, i.e. [f^p], shown in (6d), would involve the "late subtraction" or "late erasure" of an element. Such processes cannot exist in GP for the same reason cited against the Kaye, Lowenstamm and Vergnaud (1985) analysis of [p^f] in connection with (1a) above: if an element is licensed at a position and lexically attached to that position, there is nothing in the world that could cause it to subsequently fail to be licensed (pace a lazy head replacing the original head, dealt with below, which does not apply in the cases of putative [f^p]).

Now consider the behaviour of a segment like the [p^f] of (6a) in an ONO sandwich.

(7)



(The lazy element is in parentheses)

[p^f:]

[15] In a nutshell, I assume that if a complex melody M, with n elements, is well-formed in a language, then there must exist at least one well-formed melody containing n–1 elements of M.

[16] The definition of elements assumed here is given in the following table (from Rennison in press a). Only the boxed elements have been redefined. The underline mark "_" is the empty melodic position or "empty element". I assume that *all* melodic expressions have a unique head (always the rightmost element).

old	*new*	*articulatory correlates*	*acoustic correlates*
I	I	palatal	dIp* (formant structure)
U	U	labial	rUmp* (formant structure)
R	R	coronal	(formant structure)
H	H	high tone / voiceless	high F_ϕ
L	L	low tone / voiced	lower F_ϕ
N	N	nasal	nasal formant
?	_ (head of O)	stop	(almost) silence
h	_ (operator of O)	aspiration / friction	noise
A	_ (head of N)	non-high tongue body	mAss* (formant structure)
ATR	_ (operator of N)	advanced tongue root	formant structure

We see in (7) that the entire melody (U•(_)•_) is attached to both onsets, which is exactly what we want in order to capture the length alternations of Austrian German mentioned above.[17] This analysis has desirable empirical consequences: in lengthening processes, contour segments never surface with four phonetic parts, but always with two (i.e. with their single melody attached to two positions). But of course this does not preclude the possibility that two neighbouring onsets with an intervening empty nucleus happen to contain independent contour segments (e.g. in German [ˈʃuːpʊtˢtˢɔɪk] *Schuhputzzeug* 'shoe-cleaning equipment').

The definitions in (4) and (5) need further refinement in the case where the lazy element is the new head of the melodic expression. Clearly, only one element can be head, so when the new head arrives, something has to happen. There are exactly two possibilities: the new head may replace the old head entirely, or may relegate it to operator status.[18] Both cases are exemplified in 3.2. below. A third imaginable option is that it is the new head which is relegated to operator status; but if this were to happen, we would have no way of discovering that it was ever a head, because descriptively there would never be any trace of its headship. Nor would children acquiring phonology ever have grounds to assume such a demoted new head. So this third logically possibility can effectively be ignored.

The replacement of the old head cannot formally involve deletion, but is nothing more than its licensing failure when confronted with the new head. Such a-licensing failures within simplex segments are familiar from the GP literature and require no further comment here. This "partial decomposition" by a-licensing failure, it seems, is the only way in which a lexically attached element can ever be (effectively) detached from a skeletal point. Note that there is no provision for an *operator* to be replaced in any way; there can be competition and resulting a-licensing failure for head status, but never for operator status. Thus the noise (empty) operator of impossible *[f^p] could never be "deleted".

On the basis of (5) above, we can now formulate some interesting (almost-) empirical claims that seem to be borne out by the facts.

(8) a. *The first part of a contour segment can never be more complex than the second part (though the parts may be of equal complexity; if so, then the second part involves head replacement).*
b. *There are no licensing constraints or requirements between the phonetic parts of a contour segment.*

[17] In the case of German [p^f] and [t^s], the lazy empty operator is floating – a point to which I return in 4 below.

[18] Actually, I think that the old head is always replaced, but may also have been present as an operator in the original melodic expression. This representational possibility has never been discussed in the literature because up to now there was no call for it. Note, however, that in my new version of element theory there is a built-in restriction here: The empty head – old (A) or (?) – cannot also be present as an operator that receives the same phonetic interpretation; an empty operator is old ATR or (h).

Claim (8a) follows from the fact that contour segments universally involve the late *addition* of one or more elements to the phonetic realisation; in the case of head-replacement by the lazy element, the number of elements realised in the first and second phonetic parts of the contour segment may be equal. This is typically the case in labiovelarisation or palatalisation of stops [t^w, t^j] etc., where an (I) or (U) head respectively is lazy. These segments therefore have the representation in (9).[19]

(9) [t^w] (R•[_]•(U)) [t^j] (R•[_]•(I))

(Square brackets in penultimate position indicate the replaced head, round brackets indicate lazy elements.)

It is easy to see that analogous representations are available for all labialised, labiovelarised, palatalised and labiopalatalised segments.[20] However, in the case of labiovelarised labial consonants such as the [b^w] and [$ɓ^w$] of (at least one variety of) Igbo, we have the interesting case of a lazy head element, here (U), which is also a lexically attached operator. The representation of [b^w] is given in (10).

(10) [b^w] (U•[_]•(U))

Can such representations exist? If so, are they desirable? I think that the answer to both questions is yes. Phonological elements are once-only additive. In other words, it makes no difference whether an element (such as (U) in (10)) is present once or many times in the melody of a segment; its once-only effect (namely of adding its signature to the acoustic pattern) cannot be added to (as in Dependency Phonology or Particle Phonology) by the presence of a second such element. Therefore normally one would not expect to be able to detect the presence of a second (U) in a segment, and there is no call for its use in simplex segments. In [b^w], however, we have the almost unique opportunity to hear one. On the other hand, from the point of view of the free combinability of elements, the above analysis fills a gap. An element *can* be present twice in the melodic expression of a segment; but we only ever hear a difference if one occurrence of the element is lazy and of the opposite headship (i.e. both (U•U) and (U) could represent [u] or

[19] It could be argued that for all places of articulation except velar the (U) or (I) element is lexically attached to the skeleton, rather than floating. However, the existence of such segments does not preclude the present analysis, but rather predicts that some languages will have labialisation of all places of articulation and others will have a gap in the velars.

[20] Of course, the question arises whether there is any empirical difference between labiopalatalised segments with (I) or with (U) as their new head. Both (R•(I)•[_]•(U)) and (R•(U)•[_]•(I)) could be the representation of the onset of Twi [$t^{ɥ}$i]. It is feasible that evidence for the one or other representation might be accrued from effects on neighbouring segments, as in the case of the two [y]'s of Norwegian (thanks to John Harris for this observation).

[w], but the two are phonetically indistinguishable). I assume that by Occam's razor (specifically: language acquisition) no structure (U•U) is ever assumed by speakers if (U) would suffice.

The free combinability of elements is also responsible for claim (8b) above. There is only a *single* melodic expression, within which the only possible type of dominance is the obligatory head–operator relationship (which is not subject to any restrictions at all).

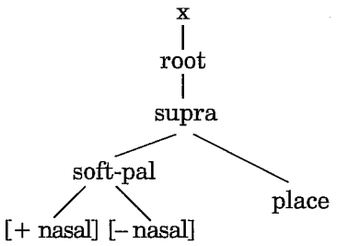
One possible disadvantage of the above analysis is that there is no way to represent a velarised segment that is not also labialised; if there is convincing evidence that such segments exist (e.g. [$t^ɯ$]), and if they cannot be represented in some other way, then I am in trouble.

1.1.2. Onsets with lazy elements: some standard cases

1.1.2.1. Prenasalised stops

Prenasalised stops, i.e. stops which are nasal in their first phonetic part and oral in their second, are analysed by Sagey (1982: 80) as in (11) for Luganda [^{n}d] in [kutaːnda] 'to betray'.

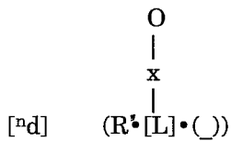
(11)



Note that there is no a priori reason in the feature geometry framework why [+nasal] should precede [–nasal]; the feature values could just as easily be reversed. However, the status of alleged postnasalised stops is by no means clear (cf. van de Weijer 1994:190 for literature and discussion). My own analysis of [^{n}d] as a single segment[21] is given in (12).

[21] By reanalysing the segment [^{n}d] in this modified GP framework I do not wish to imply that I have yet examined Luganda in sufficient detail or claim that Sagey's (1982) analysis is correct. On the contrary, since Luganda has geminates it would seem that an analysis of [nd] as an ONO sandwich (as described for Koromfe geminates and nasal + voiced stop sequences in Rennison in press b) might be more appropriate. In Kikongo, another Central Bantu language, even though there are no geminates, the nasal + obstruent sequences must be ONO sandwiches, since there exist not only [nd] but also [nt] and [nz] sequences (e.g. in [kindanda] (the surname of my informant), [muuntu] 'person', [nzɔ] 'house'). In Kinyarwanda (yet another Central Bantu language), the consonant sequences beginning with a nasal must also be ONO sandwiches.

(12)

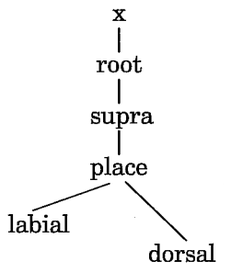


I assume that nasal stops have no stop element but simply a low tone, (L) as their head,[22] in line with proposals made by Jonathan Kaye (p.c.) and Stefan Ploch (p.c.). In (12) the replaced former head element, (L), is shown in square brackets to the immediate left of the lazy empty head element (_). Whether the replaced (L) actually remains in the representation as an empty operator or is completely replaced is not easy to decide; both variants may be possible depending on the nature of voicing in the language concerned. In other words, we can expect that in languages where voiceless stops are neutral, both [ⁿd] and [ⁿt] may occur as single (complex) onsets, represented as N(R•L•[L]•(_)) and N(R•[L]•(_)) respectively.

1.1.2.2. Labiovelars

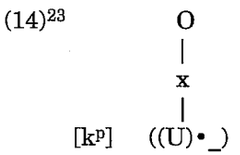
Here I make the usual distinction between labiovelars proper (i.e. segments with the same manner of articulation at both the labial and velar place of articulation) and labiovelarised obstruents (which involve a labiovelar glide [w] coarticulated with some primary obstruent). The former are restricted mainly to [kᵖ, gᵇ, ŋᵐ] while the latter can involve any place of articulation for the primary obstruent. Sagey's (1982:83) representation of labiovelars proper is given in (13) and mine in (14).

(13)



[22] If nasal stops had a stop component (in my terms, and empty head) then it would be possible to add an empty operator to get a nasal fricative. Since distinctive nasal fricatives do not exist, this cannot be the right analysis for the stops. The only case of nasal fricatives that I know of is in Koromfe: they occur phonetically only when the source of friction is external, e.g. [ɣ̃vaɣa] 'your dog', where the 2nd.sg. possessive proclitic consists of a syllabic nasal (i.e. an onset containing only (L) followed by an empty nucleus) that always surfaces as a nasal copy of the following onset – even if it is a glide or fricative (see Rennison 1993, 1997, in press b for details).

(14)[23]



The nasal labiovelar [ŋᵐ] is O((U)•L).[24]

1.1.2.3. Labiovelarised obstruents

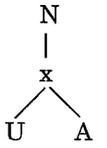
In labiovelarised obstruents, as shown in (10) above, a lazy (U) element always replaces the original head, giving O([_]•(U)) for [kʷ], O(L•[_]•(U)) for [gʷ] and O([L]•U) for [ŋʷ].

Let us now consider lazy elements in vowels.

1.2. Short diphthongs

The classical GP analysis of short diphthongs is that they are identical to the corresponding monophthongs, but for some reason their elements are realised sequentially rather than simultaneously (J. Kaye, p.c. 1989). The representation of the short diphthong [ᵘa] is given in (15).

(15)



In addition, intraconstituent government required that the (A) element be realised second because it had positive charm (which seems to me to be an arbitrary stipulation). A light diphthong [aᵘ] could not be represented. Conversely a heavy diphthong (as a branching Nucleus) could be [aᵘː] but not [ᵘaː].

This analysis is not only theoretically unsatisfactory (because it does not account for when a diphthong occurs and when a monophthong [ɔ]); it also makes wrong predictions, because all four types of diphthong exist: there is short [aᵘ], alongside long [aᵘː], in Austrian German dialects (e.g. Viennese [raᵘpːmə] – [rɔpːmə] 'caterpillar, grub' vs. [raᵘːbmə] – [rɔːbmə] 'rob'), and Mòoré (a Gur language of Burkina Faso) has both lexical and derived, long and short [ᵘa] and [aᵘ]

[23] The representation in (14) assumes that [kᵖ] is unmarked for voicing; if marked, it would need an (H) operator. The voiced counterpart of [kᵖ], i.e. [gᵇ], analogously, has either no tone element or an (L) operator.

[24] From here on, to save space, the full GP representations will be collapsed to a string of elements preceded by O or N, e.g. O((U)•_) for the representation in (14).

(see (16) for examples). Under the present proposal, both [ᵘa] and [aᵘ] are not only possible but predicted. The former is represented as N([U]•_) and the latter as N([_]•U).

Short diphthongs may also require the double presence of elements (as head and as operator). If there exist true short diphthongs such as [ᵘo] or [ⁱe],[25] and if these are distinct from [ᵘa] and [ⁱa] respectively, then their only possible analysis with single lazy elements are N(U•[U]•(_)) for [ᵘo], i.e. lexically attached (U•U) and lazy (_), and (I•[I]•(_)) for [ⁱe].

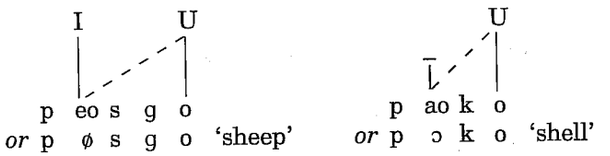
One pair of short diphthongs in Austrian German seems particularly difficult at first sight. Normally they are transcribed [ɔᵉ] and [ɛᵉ], e.g. Salzburg [lɔᵉtɐ] 'ladder', [rɛᵉpɐ] 'rascal', where [ɐ] is a low central vowel which often serves to fill an empty nucleus. Of course, if these short diphthongs really had an empty second part they would contradict the very foundations of GP. Fortunately two analyses are available which, though strange at first sight, seems quite compatible with the rest of the phonology. The first analysis is N(U•(_)•_) and N(I•(_)•_) – i.e. the diphthongs are strange pronunciations of [ɛᵉ] and [ɛᵉ] respectively. The unexpected lowering of the second part may be either due to or at least parallel to the lowering of the second part of the short diphthongs [ɔᵘ] and [ɛⁱ]. These dialects also have an ATR distinction for one pair of monophthongs ([ɛ] vs. [e], both long and short), so that the use of ATR in this analysis is not completely *ad hoc*. The second analysis would involve assuming that the lazy empty element (_) actually replaces the lexically attached (I) or (U), changing N(U•_) to ((_)•_). However, I think that the first analysis is preferable because the second would involve unmotivated a-licensing failure of a lexically attached operator – i.e. in effect subtraction. This would be a far greater problem for the theory than the a-licensing failure of an old head discussed above. In that case, something *had* to be done because it is impossible to have two heads in a melodic expression. But in the case of operators I can see no motivation for a-licensing failure triggered by the addition of a late element.

To conclude this discussion of short diphthongs, let me give three examples of elements acquired from elsewhere in the representation. In (16) we see two light diphthongs of Mòoré which result from the attachment of an (U) element of a suffix vowel (here, in both cases, the noun class suffix *-go*), and in (17) a light diphthong resulting from late attachment of the empty head element – old (A). All diphthongs in (16) and (17) also occur long.[26]

[25] The few cases of phonetic [ᵘo] or [ⁱe] in Italian are not convincing (e.g. [tᵘorlo] *tuorlo* 'yolk', [skⁱet:o] *skietto* 'sober'); the [ᵘo] cases are extremely rare, and [ⁱe] always seems to result from historical *le* by gliding of [l] to [j].

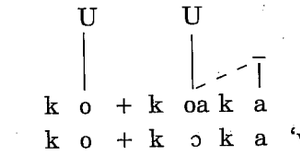
[26] In the case of long diphthongs, of course, there is no easy way to decide whether there is a single melody attached to two positions, or whether the "umlauting" elements attach only to the second N of an NON sandwich and thereby de-license the previously attached element.

(16) *"U-Umlaut" in Mòoré (a Gur language of Burkina Faso). Irrelevant structure omitted.*[27]



The (U) element in (16) cannot be analysed as a part of the lexical representation of these word stems, as can be seen from the corresponding plural forms [píisì] and [págdo] respectively, whose vowels are never diphthongised.[28]

(17) *"A-Umlaut" in Mòoré (irrelevant structure omitted).*



Here again, the acquired element cannot be analysed as a part of the stem (cf. the plural form [kòkógse], which never has a diphthong).

As in Austrian German, the choice between diphthong vs. monophthong pronunciation is dictated by the tempo and/or casualness of speech (the monophthong being the faster / more casual variant in both languages). An additional interesting detail of Mòoré is that one set of dialects (e.g. that of Ouagadougou) monophthongises the diphthongs resulting from U-umlaut but not those from A-umlaut, and another set (e.g. that of Ouahigouya) does the reverse.

2. Floating vs. acquired

I hope to have shown up to here that lazy elements that are realised late phonetically are adequate to account for contour segments. Restricting these lazy elements to floating or acquired elements means that we do not add to the inventory

[27] The attentive reader will have noticed that the "mid tense" vowels transcribed [e] and [o] have no empty head (= old (A) element). The forms given in (16) and (17) are in the traditional transcription; phonologically "mid tense" [e] and [o] are in fact high, lax [ɪ] and [ʊ] respectively (see Rennison 1990 for details). Similarly the optional [ø] is actually [ʏ], the high lax front rounded vowel. In [paoko] – [pɔko] and [kokoaka] – [kokɔka] the [g] of the respective *go* / *ga* suffix merges with the stem-final [g] to produce a (long) voiceless stop – a regular phonological process of the language that has no effect on umlaut.

[28] The change of ATR harmony class in [péosgò], pl. [píisì] is fairly rare, though there exist other words which behave similarly, especially with the *-se* suffix – perhaps a remnant of a dominant ATR harmony system. However, this anomaly has nothing to do with the (U) element under scrutiny here.

of theoretical devices of GP (e.g. by introducing a new category "lazy" for elements, which would considerably increase the theory's generative power). Let us now turn to the justification of this restriction. In particular: why should lazy elements be realised later than the rest? And if they are floating, why don't they attach somewhere else in the representation, and not on the segment with which they were introduced?

From a speech-production point of view, it seems that the lazy elements require the checking of more licensing mechanisms to determine whether they are to be realised at a particular skeletal position or not. A floating element has to be checked against a number of candidate landing sites, and an acquired element must have some special (i.e. additional) licensing mechanism to dock on to the contour segment. Contrast this with the elements which are lexically associated with a skeletal position and therefore only need to know whether they are licensed to be interpreted at that position.[29]

However, this would amount to claiming that additional cognitive effort on the part of the speaker is necessary; yet it seems that in faster / more casual speech the fusion of a complex segment to a simple one is often facilitated. I would therefore prefer to view late realisation of elements as a good way to signal their special status; recall that it is only a subset of floating or acquired elements that actually result in contour segments.

Finally, a word needs to be said about the reanalysis of (what were previously considered to be) lexically attached contour segments as segments containing a floating element. Why doesn't the floating element attach elsewhere within the domain?[30] Or if it is always realised together with the lexically attached elements of a skeletal position, why isn't it attached in the lexicon in the first place? Let us consider the case of the affricates [p^{f}] and [t^{s}] in Viennese German (which is almost identical to Standard German in this respect). There exist many words with the sequences affricate – vowel – stop, stop – vowel – affricate and affricate – vowel – affricate. Some examples are given in (18).

(18)

Viennese German	*Standard German (written)*	
p^{f}eʁt	*Pferd*	'horse'
t^{s}ɔ^{ʁ}t	*zart*	'tender'
t^{s}ɛ^{ɐ}t	*Zeit*	'time'
t^{s}ɔplə	*zappel*	'dangle, fidget, imp. sg.'
put^{s}	*putz'*	'clean, imp. sg.'
tut^{s}	*dutz'*	'use 2nd. sg. morphology, imp. sg.'
tep^{f}	*Töpfe*	'pot, pl.'
t^{s}ip^{f}	*Zipf*	'corner, tip'

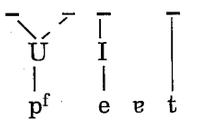
[29] I realise that at this point I seem to be imputing human language abilities to the phonological elements; clearly, it is the speaker who does all this.

[30] I am grateful to Klaus Kühnhammer for continually posing this question until eventually I came up with the obvious answer. Whether the answer is correct for all languages remains to be seen.

Superficially, it seems that a floating empty operator, old (h), would have a hard time choosing between the first stop (as in [t^{s}ɛ^{ɐ}t]) and the second (as in [tut^{s}]). However, if one considers the full representation of these words, there is always some element on the same line which prevents the spreading. The arrangement of elements on lines is, of course, still a matter of ongoing debate. Nevertheless, I contend (on independent evidence) that in languages where (old) ATR and (A) are never involved in non-local assimilations (such as vowel harmony), they must share the same tier.[31] Since ATR is (h) and (A) is (ʔ), all four of these (old) elements share the same tier in Viennese (and probably all other varieties of) German and block the attachment of floating elements by the familiar "no crossings" constraint. This effectively leaves a floating empty operator, old (h), with no choice as to where it can attach; it must attach at the skeletal point with which it was introduced into the phonological representation. This is shown in the partial representation in (19).[32]

(19) *empty element line:* old (A, ATR, ʔ, h)

I/U *line*



The empty operator in (19) could not possibly attach to the final consonant [t] to produce a form *[peɐt^{s}] because of the intervening (lexically attached) empty head of the vowel [e]. Why it does not attach to the following nucleus position is not entirely clear to me. Observationally, floating empty operators in German always attach to onsets and never to nuclei, and floating (I) and (U) to nuclei, but never to onsets. I see no general theoretical principle behind this, so it may simply be a parameter.[33]

5. Conclusion

I have tried to demonstrate that it is possible to use pre-existing formal devices (floating and acquired elements) to handle contour segments, thereby precluding any extension of the set of formal devices in the theory (in particular,

[31] Even in Mòoré, where both (A) and ATR can spread (though only ever to the next nucleus), these two elements *must* be considered to share the same line, on the evidence of mutual blocking effects (see Rennison 1996b).

[32] In (19) the syllable structure and representation of /r/ have been omitted to avoid thorny issues of analysis not relevant to the point under discussion.

[33] This point clearly deserves further investigation. If it is a parameter, then in languages with ATR harmony, we may perhaps find evidence that a floating empty operator attaches only to Nuclei. On the other hand, it may be the case that particular elements have universal preferences for attachment. But note that the latter possibility is contradicted by languages with I/U vowel harmony systems (e.g. Koromfe) vs. languages with palatalisation and labiovelarisation (e.g. Akan). What this analysis does predict, however, is that a language cannot go both ways.

subsegmental structures). As with any such attempted demonstration, it was impossible to consider all phenomena in all languages; in particular, the question of lazy coronals must be left for a future paper (Neubarth and Rennison in prep.). However, I hope at least to have encouraged some fruitful thought and discussion on this topic.

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