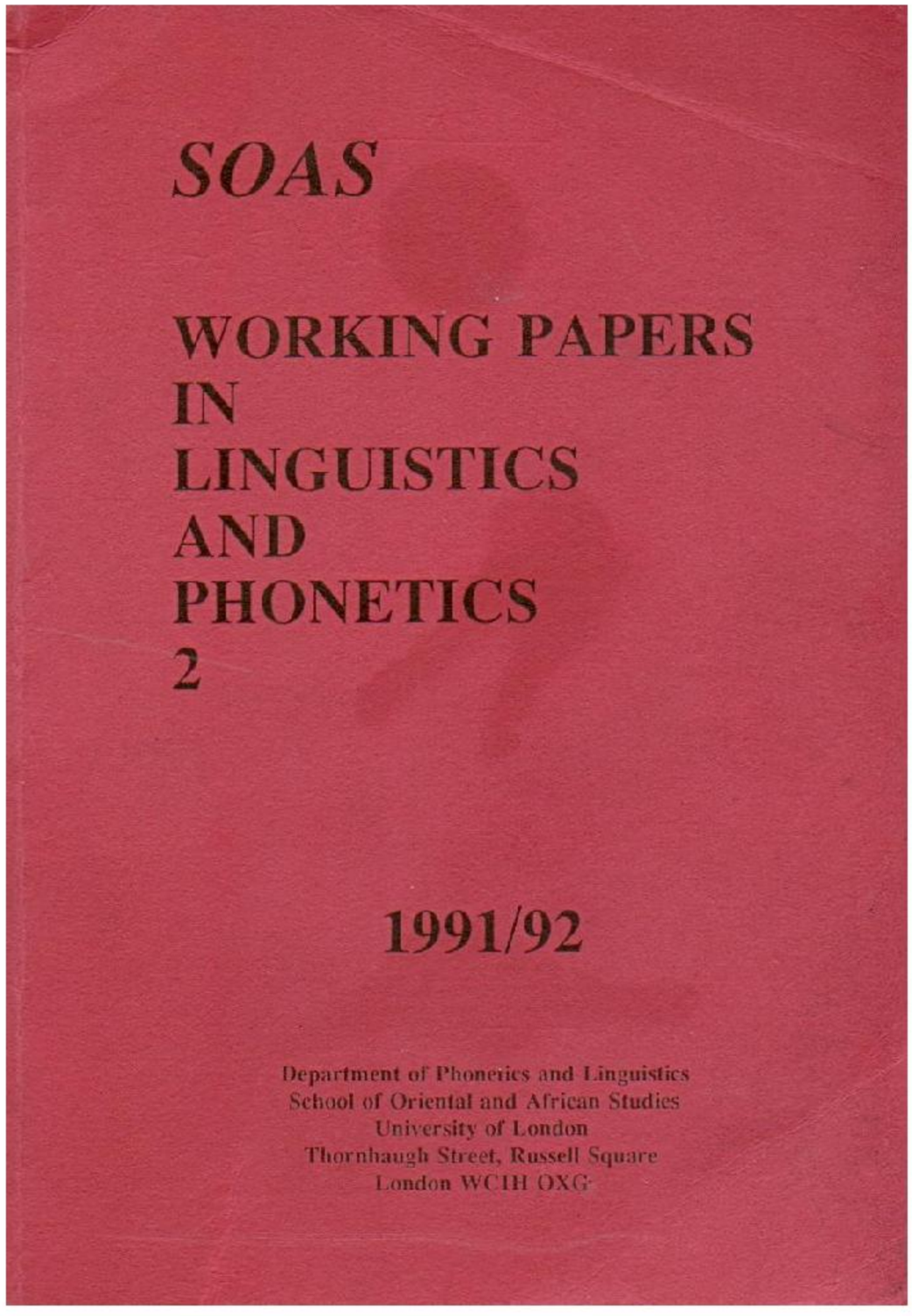

THE PHONOLOGICAL REPRESENTATION OF VELAR STOP-GLIDE SEQUENCES

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Abstract

This paper aims to investigate the phonological representation of segmental sequences which present a velar stop followed by a back glide, i.e. kw and gw.[1] Government Phonology is the framework on which our analysis is based. The data we present comes from Southeastern dialects of Brazilian Portuguese. We will show that among other potential interpretentions a sequence of a velar stop followed by a back glide must be analysed as having the structure of a complex consonant. That is, a representation where the segmental materials which correspond to the velar stop and the glide are both associated to a single onset position.

1.0. Introduction

In this paper we will determine how velar stop-glide sequences, i.e. kw and gw, are phonologically interpreted. The data we present to support our analysis comes from the Southeastern dialects of Brazilian Portuguese (henceforth BP). In the first section we present the basic assumptions assumed by Government Phonology (henceforth GP), which is the framework on which our analysis is based. Since this paper aims to investigate the phonological representation of sequences of velar stops followed by a back glide, we will emphasize how such sequences may potentially be interpreted within the GP framework. In section 2 we present BP data to discuss the potential interpretations of velar stop-glide sequences. We will show that among all potential interpretations a sequence of a velar stop followed by a back glide is best analysed as presenting the structure of a complex consonant. That is, a representation where the segmental materials which correspond to the velar stop and the glide are both associated to a single onset position.

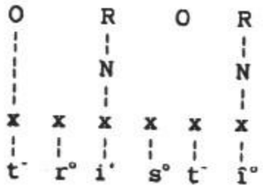
1.1. On Government Phonology

One of the tasks of GP is to explain how phonological strings are organized.[2] More precisely GP aims to explain how segments and skeletal positions are associated to phonological constituents. According to the theory phonological or lexical representations are organized as follows:

At the segmental level there is a linear sequence of segments. At the skeletal level there is a linear sequence of skeletal positions which are associated to the segments. At the constituent level there are onset-rime sequences where the rime is the immediate projection of nuclear heads. The onset-rime sequence represents what is called the syllable.[3]

Nuclear positions and their segments are lexically associated to nuclear constituents.[4] In (1) we illustrate the lexical representation of the form [tristî] 'sad'.[5]

(1)



In order to consider the syllabification of the non-nuclear positions in (1) we have to consider how phonological government operates. This is because non-nuclear positions are phonologically interpreted according to the governing relations they contract with each other. Governing relations are binary, asymmetric operations holding between adjacent skeletal positions. Given that government is a binary operation branching constituents are at most associated to two skeletal positions.[6] There are two types of governing relations: Constituent and Interconstituent.

In order for a governing relation to hold, two conditions must be satisfied: Formal and Substantive. The Formal conditions are: strict locality and strict directionality. The strict locality condition requires the governor to be adjacent to the governee at the zero level of projection. The strict directionality condition defines the nature of headship within a governing domain. Constituent government operates from left-to-right, being therefore head-initial. In a constituent governing domain the governing and the governed positions are both associated to the same constituent. Interconstituent government operates from right-to-left, being therefore head-final. In an

interconstituent governing domain the governing and the governed positions are associated to different constituents.

The substantive condition defines the governing properties of segments, i.e. whether a given segment is a governor or a governee. The theory assumes that all phonological segments are formed by a set of primitive, autonomous, independent pronounceable units which are called elements. These elements may occupy a skeletal position alone or they may combine forming a compound segment. The combinatorial possibilities of elements is defined in terms of a property called charm. Besides defining the combinatorial possibilities of elements, charm characterizes the cardinal nature of segments. Roughly speaking charm characterizes a segment either as a vowel or as a consonant.

Segments are either charmed or charmless. Charmed segments are either positively or negatively charmed. Positive charmed segments have the property of "voweliness" and they occur in nuclear head positions. Negatively charmed segments have the property of "consonantiness" and they occur in non-nuclear head positions, i.e. onsets. Charmless or neutrally charmed segments do not have either the property of "voweliness" or "consonantiness". A neutrally charmed segment may occur either in a nuclear position or in a non-nuclear position. The governing properties of segments are defined as follows: charmed segments are governors and charmless segments are governees.[7]

Given the basic conditions under which government operates we are able to consider the syllabification of the non-nuclear positions in (1). The leftmost non-nuclear position, which is filled with the negatively charmed segment t⁻, has the property of governing its immediately following position, which is filled with the neutrally charmed segment r°. In this case government operates from left-to-right defining a constituent governing domain. Therefore, the governing and the governed positions are associated to the same constituent, i.e. the initial onset.

Let us now consider the syllabification of the non-nuclear positions filled with s° and t⁻ in (1). Given that charmed segments are governors and charmless segments are governees the skeletal position filled with the negatively charmed segment t⁻ has the property of governing the preceding position, which is filled with the charmless segment s°. In this case government operates from right-to-left defining an interconstituent governing domain. In an interconstituent governing domain the governing and the governed positions are associated to different

constituents. Thus, the governing position, which is filled with the negatively charmed segment t^-, is associated to the onset constituent (which is a non-nuclear head) and the governed position, which is filled with the charmless segment s°, is associated to the rimal position. The syllabification of the form [tristî] 'sad' is given in (2).

(2)

In this paper we are concerned with the syllabification of segmental sequences which present a velar stop followed by a back glide, i.e. kw and gw. Therefore, in the following pages we will discuss how such sequences may potentially be interpreted within the GP framework.

Velar stops are usually negatively charmed segments.[8] According to the theory negatively charmed segments must occupy a non-nuclear head position, i.e. an onset.

The glide w represents the case in which the neutrally charmed element U° occupies a position other than a nuclear head. As we have mentioned above, charmless or neutrally charmed segments may occur either in a nuclear head position or in a position which is not a nuclear head. If the element U° occupies a nuclear head position it is phonetically manifested as a lax high vowel, i.e. [ʊ], whereas if the element U° occupies a position other than a nuclear head it is phonetically manifested as a glide, i.e. [w].[9] In (3) we present the potential interpretations for velar stop-glide sequences.[10]

(3)

The representations in (3) illustrate velar stop-glide-vowel sequences. The velar stop, which may be either of the negatively charmed segments k^- or g^-, is associated to a non-nuclear head position, i.e. an onset. The element U° is syllabified in a position which is not a nuclear head, so that it is realized as a back glide. The nuclear head positions in (3) are

filled with any vowel, which yields all representations in (3) to be manifested as a velar stop-glide-vowel sequence, i.e. [kwV] or [gwV]. Let us consider each structure in (3) in more detail.

(3a) illustrates an onset position filled with a velar stop immediately followed by a nuclear position filled with a light diphthong. A light diphthong consists of two segments associated to a single skeletal position. The well-formedness of a light diphthong requires the left member of the segmental sequence to be a simplex charmless element, i.e. either $U^\cdot$, I° or $v^\cdot$, whereas the right member of the segmental sequence may be either a complex charmless segment or a positively charmed segment.[11] In a light diphthong the rightmost member of the segmental sequence, which in (3a) is the vowel V, is the nuclear head. The left member of the segmental sequence in a light diphthong, which in (3a) is the element U°, does not have the properties of a nuclear head.[12] Given that in (3a) the element U° occupies a position other than a nuclear head it is manifested as a glide.

(3b) illustrates a branching onset immediately followed by a nuclear position which may be filled with any vowel. The velar stop occupies the branching onset head position and the element U° occurs in the governed position. Given that the element U° occupies the governed position in a branching onset, which is not a nuclear head position, it is realized as a glide.

(3c) illustrates an onset position filled with a complex consonant immediately followed by a nuclear position that may be filled with any vowel. In the representation of a complex consonant the element U° together with the velar consonant are both associated to a single onset position. Given that the element U° occurs in the representation of a complex consonant, i.e. a position which is not a nuclear head, it is phonetically manifested as a glide.

In the following pages we will discuss which of the structures in (3) corresponds to the representation of velar stop-glide sequences in BP.

1.1. The phonological interpretation of velar stop-glide sequences - evidence from Brazilian Portuguese

Velar stop-glide sequences in BP may or may not present alternative pronunciations where the glide is realized as a high back vowel. Consider forms in (4):

(4)	a.	[kwá⟋û]	~	[kuá⟋û]	'curd'
	b.	[agwádû]	~	[aguádû]	'watered'
	c.	[kwádrû]		*[kuádrû]	'picture'
	d.	[gwáhdɑ]		*[guáhdɑ]	'guard'

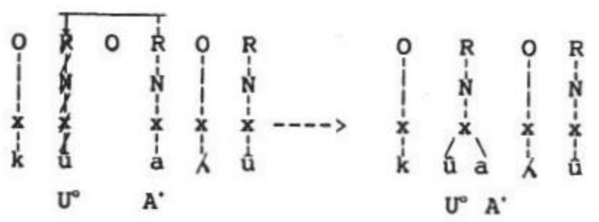
(4a,b) illustrate forms where a velar stop-glide-vowel sequence may alternate with a velar stop-vowel-vowel sequence (cf. forms on the right).[13] That is, the segmental material flanked between the velar stop and the vowel may be either a glide or a high vowel.

In (4c,d) a velar stop-glide-vowel sequence must be pronounced, i.e. in these forms the glide may not alternate with its corresponding high vowel.

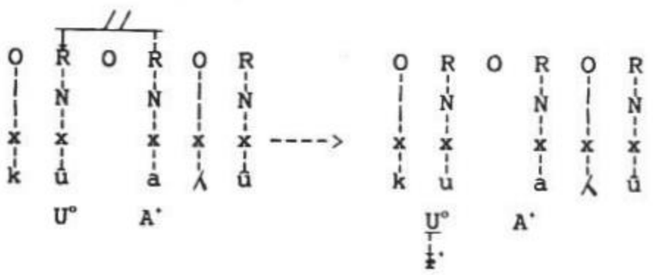
In the next pages we will initially address how forms in (4a,b), i.e. where either a glide or a high vowel may be manifested, are phonologically analysed. Later we will address the phonological interpretation of forms such as in (4c,d), i.e. where a glide must occur.

We propose that forms where a glide alternates with its corresponding high vowel, e.g. [kwá⟋û] ~ [kuá⟋û] 'curd' (c.f. (4a)), are derived from a sequence of nuclear positions where the leftmost nuclear position is filled with a high vowel (c.f. SILVA (1992)). In (5) we illustrate the derivation of the forms [kwá⟋û] ~ [kuá⟋û] 'curd' (cf. (4a)):[14]

(5) a. [kwá⟋û]



b. [kuá/û]



(5a) illustrates the derivation of the form [kwá⟋û], in which a glide is flanked between the velar stop and the vowel. We assume that forms presenting a glide-vowel sequence - which may also be manifested as a sequence of vowels - are derived by the establishment of an interconstituent governing relation between nuclei. That is, a governing relation which holds between a sequence of strictly adjacent nuclear positions, where the rightmost one has the property of governing the nuclear position to its left.

Recall that in order for a governing relation to hold between two adjacent positions the head must have the adequate charm value to govern its complement. Let us briefly summarize the governing properties of nuclear segments.[15] Nuclear segments may be either positively charmed or charmless. A nuclear position filled with a positively charmed segment has the property of governing another nuclear position filled with a charmless segment. A charmless segment may govern another charmless segment if it has a complexity greater than its governee. Positively charmed segments cannot be governed.

Notice that in (5a) the rightmost nucleus, which is filled with the positively charmed element A', has the property of governing the nuclear position to its left, which is filled with the simplex charmless element U°. Given that in (5a) government operates from right-to-left we have an instance of interconstituent government.

We claim that the establishment of an interconstituent governing relation between nuclei yields to the loss of the governed nuclear position, which in (5a) is filled with the simplex charmless element U°. The element U° which was associated to the governed nuclear position (i.e. the nuclear position we claim is deleted by the establishment of an interconstituent governing domain) is then incorporated to its governor nucleus, forming a light diphthong. Given that the element U° occupies a position which is not a nuclear head it is realized as a glide, i.e. [w]. A glide-vowel sequence is manifested.

(5b) illustrates the derivation of the form [kuá⟋û], in which a high vowel is flanked between the velar stop and another vowel. We assume that forms which present a sequence of a high vowel followed by another vowel - where the high vowel may also be realized as a glide - are derived by preventing the loss of a nuclear head position. We claim that in order to prevent the loss of a nuclear position, which takes place under the establishment of an interconstituent governing relation between nuclei (c.f. (5a)), the nuclear position filled with the simplex charmless

segment û (which is a potential governee) acquires the ATR element into its internal representation so that it becomes positively charmed.[16]

Notice that in the rightmost representation illustrated in (5b) the adjacent nuclear positions are both filled with positively charmed segments. Recall that positively charmed segments cannot be governed. Thus, no governing relation holds between the adjacent nuclear positions in (5b) because they are both filled with positively charmed segments. Since no governing relation holds between the adjacent nuclear positions in (5b), no nuclear position is deleted. A sequence of vowels is manifested.

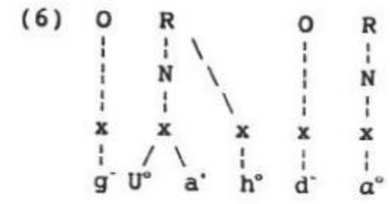
We have seen above that velar stop-glide-vowel sequences may correspond to the representation of an onset filled with a velar consonant which is immediately followed by a nuclear position filled with a light diphtong (c.f. (5a)). We have shown that the glide represents the element U° syllabified in the structure of a light diphtong which is derived by the establishment of an interconstituent governing relation between nuclear positions.

In the following pages we will be concerned with the phonological representation of forms in which a glide must be manifested, e.g. [gwáhdɑ] 'guard' but *[guáhdɑ]. In these forms the glide represents the case in which the element U° is lexically associated to a position other than a nuclear head, instead of being derived by phonological processes.[17]

In (3) we illustrated the potential representations for velar stop-glide-vowel sequences. In the following pages we will consider each of those representations in detail in order to find out which one corresponds to the syllabification of velar stop-glide-vowel sequences in BP, where the glide represents the element U° lexically associated to a position other than a nuclear head.

In (6) we illustrate the representation of the form [gwáhdɑ] 'guard' (c.f. (4d)), where the glide corresponds to the element U° lexically associated to a nuclear position filled with a light diphthong.

(6)



The first argument against a structure like (6), where the glide represents the element U° lexically associated to a nuclear position filled with a light diphthong, comes from the lack of restrictions concerning the vowel in the glide-vowel sequence. This is because in languages which present lexical light diphthongs there are constraints with respect to the nature of the vowel in the vowel-glide sequences which correspond to light diphthongs (cf. KAYE (1989e)).

If we consider French, which is a language that has lexical light diphthongs, we observe that there are restrictions with respect to which vowels can occur in the glide-vowel sequence. That is, the vowel which follows the back glide which is syllabified in the representation of a light diphthong in French can only be a̲, ẽ̲ or õ̲ as in [wat] 'wad of cotton', [lwẽ] 'far' and [lwõ] 'we rent'.[18] Thus, in vowel-glide sequences which correspond to the structure of a light diphthong there will be restrictions with respect to the vowel.

If in forms such as [gwáhdɑ] 'guard' the glide-vowel sequence represents a light diphthong - as proposed in (6) - then we expect that there will be constraints concerning which vowels can follow the glide. Consider (7).

(7)

a.	[gwáhdɑ]	'guard'
b.	[kãgwẽ́tɑ]	'stool-pigeon'
c.	[sekwẽ́lɑ]	'sequel'
d.	[lĩgwisɑ]	'sausage'
e.	[akwózû]	'aqueous'
f.	[kwôtɑ]	'quota'

Forms in (7) show that the glide in velar stop-glide-vowel sequences can be followed by any vowel from BP.[19] Thus, the lack of constraints concerning the vowel in the glide-vowel sequence - namely any vowel can follow the glide - provides us with evidence that the representation of glide-vowel sequences in BP, where the glide represents the element U° lexically associated to a position other than a nuclear head, does not correspond to the structure of a light diphthong. This is because if the glide-vowel sequence corresponded to the structure of a light diphthong, there should be constraints with respect to which vowels can follow the glide, which is not the case.

More evidence that, in forms where the back glide corresponds to the element U° lexically associated to a position other than a nuclear head, the glide does not represent the element U° syllabified in the representation of a light diphthong - as proposed in (6) - comes from the fact that glide-vowel sequences in BP cannot be preceded by branching onsets, e.g. *[grwáhdɑ].[20] Recall that in a light diphthong both

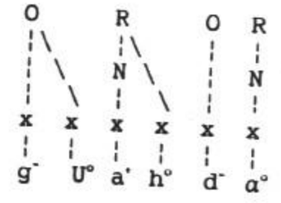
the glide and the vowel are associated to the same nuclear position (c.f. (3a, 5a, 6)). Thus, given that the glide occurs in a nuclear position there should be no restriction on whether the preceding onset is branching or not. That is, we should find forms where the glide-vowel sequence is preceded by a branching onset, which is not the case.[21]

Finally, there are restrictions with respect to which segmental material may occupy the onset position which precedes the light diphthong: namely, only velar stops may precede the glide-vowel sequence. This restriction leads us to exclude a representation such as (6) for velar stop-glide-vowel sequences in BP, where the glide corresponds to the element U° lexically associated to a position other than a nuclear head. This is because it would be ad hoc to impose a constraint which requires light diphthongs to be preceded by a velar stop consonant.

The facts we have discussed above show that glide-vowel sequences in BP, where the glide represents the element U° syllabified in a position other than a nuclear head, do not correspond to the structure of a light diphthong. That is, a structure such as the one illustrated in (3a) is excluded.

Let us then consider (3b) which represents the element U° syllabified in the governed position of a branching onset. Assuming that in a form like [gwáhdɑ] the glide is syllabified in the governed position of a branching onset, we have the representation illustrated below:

(8)



Assuming the representation in (8), we are led to predict that whenever the back glide occurs it will be preceded by a consonant - which will be the head of the branching onset governing domain. Indeed, as we have seen, in the cases where the back glide corresponds to the element U° lexically associated to a position other than a nuclear head, a consonant must precede the glide.

A problem which arises from assuming the branching onset hypothesis is that there are restrictions with respect to which consonant can precede the glide. As we have seen, all forms where the back glide represents the element U° lexically associated to a position other than a nuclear head, a velar stop

consonant must precede the glide.

Branching onsets may present either stops or non-sibilant fricatives in the governing position, e.g. [plánũ] 'plan' or [livrũ] 'book'. Therefore, if we assume that velar stop-glide sequences correspond to the structure of a branching onset, we have to explain why the glide must be preceded by a velar stop and not by any other stop or non-sibilant fricative, i.e. we have to explain why sequences such as *[pwa] or *[vwa] do not occur. In order to account for the fact that back glides must be preceded by velar stops we would have to impose an ad hoc constraint to branching onsets which correspond to velar stop-glide sequences. This constraint would require only velar stop consonants to occupy the branching onset head position when the element U° occupies the governed position in the branching onset.

Although the branching onset hypothesis leads us to impose an ad hoc constraint which restricts only velar stop consonants to occupy the governing position of branching onsets, it allows us to account for the lack of forms where branching onsets precede back glides (which represent the element U° lexically associated to a position other than a nuclear head) i.e. *[grwádɑ].[22] Constituents are maximally binary, i.e. branching constituents are at most associated to two skeletal positions. Thus, if in a form like [gwáhdɑ] 'guard' the glide represents the element U° syllabified in the governed position of a branching onset, the presence of the glide maximises the onset. Given that constituents are maximally binary, we expect not to find forms where the back glide is preceded by a branching onset, and that is exactly the case.

Therefore, if we assume that the back glide represents the element U° syllabified in the governed position of a branching onset we can give a reasonable explanation for the lack of forms where a branching onset precedes the glide, i.e. *[grwádɑ]. On the other hand, as we have mentioned above, this proposal would lead us to impose an ad hoc constraint which requires only velar stops to occupy the governing onset position when the element U° occurs in the governed position of a branching onset.

However, there is a way by which we can confirm whether velar stop-glide sequences correspond to the structure of a branching onset. This is by comparing the phonological behaviour of velar stop-glide sequences to the phonological behaviour of obstruent-liquid sequences, which do correspond to the structure of branching onsets.

In the following pages we will consider a phonological process which involves obstruent-liquid sequences in BP.[23] Therefore, if back glides represent the element U° syllabified in the governed position of a branching onset, we expect forms which present velar stop-glide sequences to behave like any branching onset in BP. In (9) we illustrate forms which present obstruent-liquid sequences followed by a primary stressed vowel.

(9)	a.	[prátû]	'plate'
	b.	[frévû]	'frevo(dance)'
	c.	[brɛ́vî]	'brief'
	d.	[krímî]	'crime'
	e.	[grósû]	'thick'
	f.	[trɔ́kɑ]	'change'
	g.	[blúzɑ]	'blouse'

Forms in (9) show that obstruent-liquid sequences can be followed by any primary stressed vowel from BP. In (10) we illustrate forms where the obstruent-liquid sequence occurs followed by a nuclear position which does not bear primary stress.

(10)	a.	[ezéplû]	'example'
	b.	[ótrû]	'other'
	c.	[séprî]	'always'
	d.	[lívrû]	'book'
	e.	[flamégû]	'Flamengo'
	f.	[brazilérû]	'brazilian'
	g.	[kõprimídû]	'tablet'
	h.	[kõplikádû]	'complicated'

Forms in (10a-d) illustrate the case in which the obstruent-liquid sequence occurs in a position that follows the primary stressed vowel. Forms in (10e-h) illustate the cases in which the obstruent-liquid sequence occurs in a position that precedes the primary stressed vowel. In all forms illustrated in (10), i.e. where an obstruent-liquid sequence is followed by a vowel that does not bear primary stress, the obstruent-liquid sequence may occur as a single consonant, i.e. only the onset head is realized. This process is illustrated in (11):[24]

(11)	a.	[ezéplû]	~	[ezépû]
	b.	[lívrû]	~	[lívû]
	c.	[brazilérû]	~	[bazilérû]
	d.	[kõplikádû]	~	[kõpikádû]

Forms in the left column in (11) illustrate the case where a sequence of obstruent-liquid is pronounced, and forms in the rightmost column illustrate the cases where only the obstruent is phonetically manifested.

The process illustrated in (11), where an obstruent-liquid sequence alternates with an obstruent, takes place only if the vowel which follows the obstruent-liquid sequence does not bear primary stress. Therefore, in the cases where the obstruent-liquid sequences are followed by a primary stressed vowel, e.g. [prátû] 'plate' (c.f. (9)), an obstruent-liquid sequence must be phonetically manifested, i.e. *[pátû].

As we have just seen, a branching onset, i.e. an obstruent-liquid sequence, alternates with a non-branching onset, i.e. an obstruent, if the vowel which follows the branching onset does not bear primary stress. Thus, if in forms which present a velar stop-glide sequence, e.g. [gwáhdɑ] 'guard', the glide represents the element U° syllabified in the governed position of a branching onset - as illustrated in (8) - we expect the velar stop-glide sequence to alternate with a velar stop if the vowel which follows the velar stop-glide sequence does not bear primary stress. Consider forms in (12):

(12)	a.	[gwahdanápû]	*[gahdanápû]	'serviette'
	b.	[akwarɛ́lɑ]	*[akarɛ́lɑ]	'water colour'
	c.	[lígwɑ]	*[ligɑ]	'language'
	d.	[inikwɑ]	*[inikɑ]	'iniquitous'

Forms in (12) illustrate velar stop-glide sequences followed by a nuclear position which does not bear primary stress. In (12a,b) the velar stop-glide sequence is followed by a nuclear position that precedes primary stress and in (12c,d) the velar stop-glide sequence is followed by a nuclear position that follows primary stress.

If velar stop-glide sequences corresponded to the structure of a branching onset - as proposed in (8) - we expected the cluster velar stop-glide to alternate with a single velar stop when it is followed by a vowel that does not bear primary stress. However, this is not the case, as illustrated in forms in the right-hand column in (12).

Thus, the fact that the velar stop-glide sequences in (12) do not alternate with a velar stop, gives us evidence that the phonological representation of velar stop-glide sequences does not correspond to the structure of a branching onset.

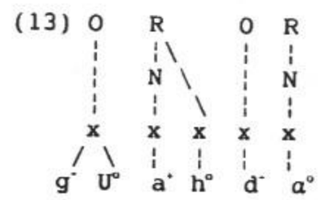
Further evidence that velar stop-glide sequences do not correspond to the structure of a branching onset - as proposed in (8) - comes from the distribution of postonic velar stop-glide sequences in antepenultimate stressed forms. That is, whereas obstruent-liquid

sequences - which do correspond to the structure of a branching onset - can occupy the final onset position in antepenultimate stressed forms, e.g. [kitûplû] 'quintuple', velar stop-glide sequences cannot, i.e. *[kitûkwa]. If velar stop-glide sequences corresponded to the structure of a branching onset we would expect to find forms where velar stop-glide sequences occur in the final onset position of antepenultimate stressed forms, which is not the case."

As we have seen the proposal that velar stop-glide sequences correspond to the structure of branching onsets cannot be sustained. Therefore, the branching onset hypothesis - proposed in (8) - is excluded.

Let us consider the remaining possibility for the syllabification of velar stop-glide sequences which was given in (3c). That is, the structure of a complex consonant where the segmental material corresponding to the velar stop and the glide occupy a single onset position. In (13) we illustrate the syllabification of the form [gwáhda] according to the complex consonant hypothesis:

(13)



Assuming the complex consonant hypothesis we may account for the fact that the consonant which precedes the glide must be a velar stop. This is because complex consonants present restrictions with respect to the segmental materials which may occupy their skeletal positions. However, the representation of complex consonants has still to be better understood. The nature of headship in complex consonants (if there is any head) is not yet clear. The fact that a complex consonant cannot be the head of a branching onset still deserves further consideration. In the following pages we will consider in more detail the consequences of assuming the complex consonant hypothesis with the aim of throwing some light on the discussion of the representation of complex consonants.

Most of the forms which present velar stop-glide sequences which we have considered in the preceding pages illustrate instances where the glide corresponds to the element U° lexically associated to a position other than a nuclear head. In these cases the glide cannot alternate with its corresponding high vowel. However, in (4a,b) we gave some forms where the glide may alternate with its corresponding high vowel, e.g.

[kwáʎû] ~ [kuáʎû] 'curd' (c.f. (4a)). In these latter cases whether a glide-vowel sequence or a vowel-vowel sequence occurs depends on the governing relations established between adjacent nuclear positions (c.f. (5)).

It is important to mention that the glide-vowel alternation process takes place only if the glide/high vowel occurs in pretonic position, e.g. [kwáʎû] ~ [kuáʎû] 'curd'. In postonic position a glide must be phonetically manifested, e.g. [ī génwa] b u t *[īgénûa] 'ingenuous'. Therefore, in postonic position a glide must occur regardless of whether it is derived from a sequence of nuclear positions or whether it represents the element U° lexically associated to a position other than a nuclear head.

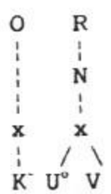
Notice that the phonological interpretation of postonic velar stop-glide sequences appears to be ambiguous when they occur in postonic position. This is because postonic velar stop-glide sequences may potentially represent either the case where the glide represents the element U° lexically associated to a position other than a nuclear head or the glide may represent the element U° syllabified in the representation of a light diphthong which is derived by the establishment of an interconstituent governing relation between nuclei. Consider forms in (14):

(14) a. [inikwa] 'iniquitous'
b. [lígwa] 'language'
c. [inŌkwa] 'innocuous'
d. [ágwa] 'water'

All forms in (14) present postonic velar stop-glide sequences. Thus, we have to determine whether the postonic glide corresponds to the element U° lexically associated to a position other than a nuclear head, i.e. within the structure of a complex consonant, or whether the glide is derived from a sequence of nuclear positions, in which case the glide represents the element U° syllabified within the structure of a light diphthong. These two possibilities are illustrated in (15):

(15) a.

b.



In order to determine how the back glide is interpreted in postonic velar stop-glide sequences we have to consider derived forms where the velar stop-

glide sequence occurs in pretonic position.

Recall that in cases where a pretonic glide is derived from a sequence of nuclear positions it alternates with its corresponding high vowel, e.g. [kwá⸝û] ~ [kuá⸝û] 'curd'(c.f (5)). On the other hand if the pretonic glide corresponds to the element U° syllabified in the representation of a complex consonant, it cannot alternate with its corresponding high vowel, e.g. [gwáhdɑ] but *[guáhdɑ] 'guard'. Consider forms in (16):

(16)
a.[inikwidádî] *[inikuidádî] 'iniquity'
b.[lîgwístîkɑ] *[lîguistîkɑ] 'linguistics'

c.[inokwidádî] ~ [inokuidádî] 'innocuousness'
d.[agwádû] ~ [aguádû] 'watered'

(16) illustrates derived forms of the nouns listed in (14). Forms (16a,b) show that the pretonic glide cannot alternate with its corresponding high vowel. Forms in (16c,d) show that either a pretonic glide or a high vowel may be phonetically manifested.

The derived forms illustrated in (16) lead us to determine the correct phonological interpretation of the glide in forms which present postonic velar stop-glide sequences - as illustrated in (14). That is, in forms such as (14a,b), i.e. [iníkwɑ] and [lígwɑ], the glide corresponds to the element U° syllabified in the representation of a complex consonant. That is why in the derived forms [inikwidádî] and [lîgwístîkɑ] (c.f. (16a,b)) the pretonic glide cannot alternate with its corresponding high vowel, i.e. *[inikuidádî] and *[lîguistîkɑ].

On the other hand, in forms such as (14c,d), i.e. [inǒkwɑ] and [ágwɑ], the glide corresponds to the element U° syllabified in the representation of a light diphthong, i.e. the glide is derived from a sequence of nuclear positions. This is why in the derived forms [inokwidádî] ~ [inokuidádî] and [agwádû] ~ [aguádû] (c.f. (16c,d)) the pretonic glide alternates with its corresponding high vowel.

We have just seen that in postonic velar stop-glide sequences the glide may be interpreted as either the element U° syllabified in the representation of a complex consonant, in which case it represents the element U° lexically associated to a position other than a nuclear head, or the glide may be interpreted as the element U° syllabified in the representation of a light diphthong, in which case it is derived by the establishment of an interconstituent governing relation between nuclei (c.f. (5)).

In the following pages we will consider the distribution of velar stop-glide sequences in relation to the primary stressed vowel. We will see that the occurrence of postonic velar stop-glide sequences where the glide represents the element U° syllabified in the representation of a light diphthong, and the occurrence of velar stop-glide sequences where the glide represents the element U° syllabified in the representation of a complex consonant, are potentially distinct in relation to the primary stressed vowel.

Primary stress in BP may be either final, e.g. [kakí] 'caqui (fruit)', penultimate, e.g. [kázɑ] 'house' or antepenultimate, e.g. [sílɑbɑ] 'syllable'.[26] Notice that in the cases where a postonic glide is derived from a sequence of adjacent nuclear positions, primary stress must fall on the nuclear position which immediately precedes the glide, i.e. [inǒkwɑ] but *[inOkwɑ] 'innocuous'. This is because the nuclear position which immediately precedes the glide is the third-to-last nuclear position which corresponds to the antepenultimate stress pattern. Stress cannot fall on the second-to-last nuclear position that precedes the glide, i.e. *[inOkwɑ], because in this case primary stress would be assigned to the fourth-to-last nuclear position, which is not possible in BP.

Notice, however, that in the cases where the glide represents the element U° syllabified in the structure of a complex consonant, we expect to find forms which present postonic glides where primary stress falls on the second-to-last nuclear position which precedes the glide, e.g. [inîkwɑ] should be a possible form. This is because if the glide corresponds to the element U° syllabified in the structure of a complex consonant it occupies an onset position. Thus, in a form such as [inîkwɑ] stress would fall on the third-to-last nuclear position corresponding to the antepenultimate stress pattern. However, forms such as *[inîkwɑ], i.e. where primary stress falls on the second-to-last nuclear position which precedes the glide, have not been reported in BP.

We have just seen that to assume the complex consonant hypothesis leads us to predict that we should find forms where primary stress falls on the second-to-last nuclear position which precedes the glide. However, such forms, e.g. *[inîkwɑ], do not occur in BP. The lack of such forms may be assumed as a gap in the system, or it may be related to some constraint imposed on postonic constituents. Although some more research has to be done on this issue we believe that the lack of postonic velar stop-glide sequences is accounted for by phonological constraints. Below we will point out some constraints imposed on postonic constituents in BP in an attempt to explain why we do

not find forms which present velar stop-glide sequences where primary stress falls on the second-to-last nuclear position which precedes the glide, i.e. *[ínîkwa].

Penultimate postonic constituents in BP may be any other than branching nuclei, i.e. forms presenting postonic heavy diphthongs, e.g. *[pátaw], do not occur.[27] Antepenultimate postonic constituents are grouped in two sets. In the first set only the antepenultimate stressed nucleus may not be branching, i.e. *[páwmaka].[28] In the second set postonic nuclei may not be branching, i.e. *[pámawka] or *[pámakaw], neither can postonic rimes, i.e. *[pámaska]. Regarding postonic onsets, the second one cannot be filled with palatal consonants, i.e. [š,ž,ʎ,ñ], or with the segment [h], e.g. *[pámaʎa] and *[pámaha] are not possible forms in BP.[29]

The representation of palatal consonants is not fully understood yet. However, there is evidence for assuming that the palatal lateral [ʎ] and the palatal nasal [ñ] in BP behave as a complex consonant.[30] Notice that, interestingly, the palatal lateral and the palatal nasal are not allowed to occur in the final onset position of antepenultimate stressed forms, i.e. *[mánîʎa] and *[kámîñû]. This is exactly the environment where velar stop-glide sequences - which we propose have the structure of a complex consonant - are not allowed to occur either. Thus, we may assume that the same constraint which excludes palatal laterals and palatal nasals from occupying the second postonic onset position in antepenultimate stressed forms, i.e. *[mánîʎa] or *[kámîñû], rules out antepenultimate stressed forms which present postonic velar stop-glide sequences, i.e. *[inîkwa].

Further research has still to be done on determining the internal representation of complex consonants. The nature of headship in complex consonants (if there is any head) is not clear yet. The fact that a complex consonant cannot be the head of a branching onset, i.e. *[gwráda], deserves further consideration. The reason why constraints are imposed on the final onset in antepenultimate stressed forms - which may not be filled with complex consonants - has yet to be found.

1.2. Conclusion

In this paper we have shown that velar stop-glide sequences, where the glide represents the element U° lexically associated to a position other than a nuclear head, are better understood as corresponding to the structure of a complex consonant. However, further research is needed for the full understanding of the internal representation of complex consonants as well as for the understanding of the constraints imposed on onsets which are filled with complex consonants. We hope that the data and analysis presented in this paper will be useful for future research on this issue.

NOTES

1. The analysis presented in this paper is part of the research done for my PhD dissertation, "Nuclear Phenomena in Brazilian Portuguese" (c.f. SILVA (1992)). I would like to thank Dr. Charette for the useful comments made on an earlier version of this article.

2. For other lines of research in GP and a full presentation of the theory, as well as theoretical evidence for its basic assumptions see KAYE, J., LOWENSTAMM, J. & VERGNAUD, J.-R. (1985,1990), CHARETTE, M. (1988, 1991) and KAYE, J. (ed.) (1990).

3. In GP the nucleus, onset and rime are the only constituents present in phonological representations. Evidence for denying the so-called Coda constituent is given in KAYE (1989c). As for the arguments on denying the syllable as a phonological constituent see KAYE (1989e) and KLV (1990).

4. This property follows from the "Licensing Principle" which establishes that all positions in a domain must be licensed except the head of this domain (Cf. KAYE (1989e)).

5. The superscripts on the segments given in (1) correspond to their charm value. The role of charm in phonological representations will be addressed shortly.

6. See KLV (1990) for the demonstration of the "Binary Theorem".

7. Later research has shown that the governing property of a non-nuclear segment involves not only its charm value but also its complexity (cf. KLV (1990)). A governing relation still holds between two charmless non-nuclear positions where the charmless

governing position has a complexity greater than its governee. For details on the charm value and complexity of segments occurring in non-nuclear head positions see HARRIS (1990), YOSHIDA (1991).

8. There are cases in which velar stops correspond to neutrally charmed segments. For example in a form such as [dOktɑr] 'doctor' in English the velar stop is a charmless segment which occupies the rimal position. The rimal position which is filled with the neutrally charmed velar stop is governed by the following onset position which is filled with negatively charmed segment t̠.

9. The same behaviour is attested for the element I° which may be realized either as a lax high vowel, i.e. [ɪ], or as a palatal glide, i.e. [j].

10. For convenience of discussing the representations illustrated in (3) we have used the symbol k to represent either of the velar stops. The symbol V stands for any vowel.

11. Light diphthongs correspond to what has been called rising diphthongs. For a detailed discussion on light diphthongs and for details on the internal representation of the segments which may occupy light diphthong positions see KAYE (1985, 1990b), CHARETTE (1988), SILVA (1992).

12. Although two segments occupy a nuclear position in the representation of a light diphthong, only the rightmost member of the segmental sequence has the properties of a nuclear head. For example, stress must be assigned to nuclear heads. Considering light diphthongs, it is the rightmost segment which will bear stress. Therefore, in a light diphthong the rightmost member of the segmental sequence is the nuclear head and the leftmost one occurs in a position which is not a nuclear head.

13. In forms where a glide alternates with its corresponding high vowel the consonant which precedes the glide-vowel or the vowel-vowel sequence may be not only velar stops - as illustrated in (4a,b) - but any consonant of BP.

14. The phonological expressions which appear below the segments associated to the nuclear positions in (5) correspond to the internal representation of those segments.

15. For details on this issue see KLV (1985), HARRIS (1990), YOSHIDA (1991) and SILVA (1992).

16. For lack of space we refrain from discussing the arguments which support our claim that the ATR element is incorporated into the internal representation of the simplex charmless segment û. Details of this issue, which involves the distribution of BP vowels in relation to the primary stressed position, are given in SILVA (1992).

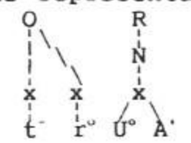
17. In postonic position glide-vowel sequences must occur regardless of whether the glide corresponds to the element U° lexically associated to a position other than a nuclear head (in which case a glide must occur following a velar stop), e.g. [lígwɑ] 'language', or whether the glide is derived from a sequence of nuclear positions (c.f. (5a)). In the latter case the consonant which precedes the glide may be other than a velar stop, e.g. [tẽnwi] 'tenuous'. We will address forms which present postonic glide-vowel sequences later in this paper.

18. Light diphtongs in French which are manifested as palatal glide-vowel sequences may present other vowels than a,ẽ,õ in the vowel position, e.g. [jOd] ' (iode) 'iodine'. For details on light diphthongs in French see KAYE & LOWENSTAMM (1984), KAYE (1989b) and CHARETTE (1988).

19. In (7) the vowel which follows the glide bears primary stress. In primarily stressed positions the following vowels occur in BP: [a,e,ɛ,i,o,O,u]. The only constraint in forms in (7) is that the glide cannot be followed by the vowel u, i.e. *[kwu].

20. We stress that only glide-vowel sequences where the glide corresponds to the element U° lexically associated to a position other than a nuclear head may not be preceded by branching onsets. However, glide-vowel sequences which are derived from a sequence of nuclear positions, where the glide may alternate with its corresponding high vowel (c.f. (5)), may be preceded by branching onsets, e.g. [mẽstrwádɑ] ~ [mẽstruádɑ] 'menstruating'.

21. If we consider French, which is a language that has lexical light diphthongs, we notice that a glide-vowel sequence can be preceded by a branching onset, e.g. [trwa] 'three'. The representation of the form [trwa] is given below:



22. As we mentioned before, forms in which the back glide is derived from a sequence of nuclear positions may be preceded by branching onsets, e.g. [mēstrwádɑ] 'mestruating'. In this case there is an alternative pronunciation where a sequence of vowels is realized, e.g. [mēstruádɑ].

23. For more details of this process see SILVA (1989b)).

24. The examples in (11) represent a sample of the forms given in (10). All forms in (10) may undergo the process illustrated in (11).

25. The reason why velar stop-glide sequences cannot occupy the final onset position in antepenultimate stressed forms is addressed later in this paper.

26. In a few forms, which have still to be better understood, primary stress may fall on the fourth-to-last nuclear position, e.g. [hítîmîkɑ] 'rythmic'. All forms which are stressed on the fourth-to-last syllable are derived forms which present the suffix -ik.

27. A few forms present postonic nasal heavy diphthongs, e.g. [õhfãw] 'orphan'. These forms comprise a small set, and involve a process of vowel nasalization (where the nasal consonant does not surface) which deserves further analysis.

28. There are a few forms, e.g. [náwtîkû] 'nautical', which present antepenultimate branching nuclei. However, these forms are treated as exceptional. That is, they belong to a small set of forms which present the suffix -ik where primary stress may exceptionally fall on the fourth-to-last nucleus.

29. The segment [h] corresponds to the so-called 'strong R' which has specific phonological behaviour. For details of the distribution and analysis of the 'strong R' see SHAW (1986), LOPEZ (1979) and OLIVEIRA (1983).

30. For arguments on this proposal see SILVA (1990).

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