

The Havlík Pattern and Directional Lower

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1. Introduction

Vowel-zero alternations are a classical topic in the study of Slavic languages and have produced an important body of literature. Since Lightner (1965), the Slavic pattern was accounted for by the so-called *Lower rule*. Following the evolution of phonological theory, the rule was then successively implemented in linear SPE, autosegmental and constraint-based frameworks.

In this article we draw attention on another regularity that is found in Slavic languages, the *Havlík pattern*, which also concerns vowel-zero alternations but shows a different management of sequences of alternating vowels: instead of the vocalization of all alternating vowels in a row that is observed in the Lower pattern (e.g. Czech *dom-eč-ek* ‘house, double dim.’), only every other alternating vowel is vocalized (counting from the right edge) in systems that are governed by Havlík (e.g. Old Czech *dom-øč-ek* ‘id.’).

Since the Lower and the Havlík pattern follow the same regularity except for the treatment of sequences of alternating vowels, an adequate analysis should be able to account for the Lower-Havlík variation in terms of a parametric choice that informs a basic mechanism. We show that a solution along these lines is available if Lower, which establishes a relationship between two nuclei, is made directional, i.e. applies from right to left. This perspective follows a short remark made by Jerzy Rubach in his 1984 book (Rubach 1984:190).

Regressive Lower, which is called government in Government Phonology, may then describe the variation in terms of a lexical property of affixes: the concatenation of an affix may or may not trigger

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interpretation (Halle and Vergnaud 1987). In case it does (i.e. in case of cyclic affixes), Lower is derived, while their interpretation-neutrality (i.e. non-cyclicity) produces the Havlík pattern. In our example, the only thing that has happened in the evolution of Czech is that the diminutive suffix *-ek* was non-cyclic in Old Czech and has become cyclic in Modern Czech.

2. The Lower pattern and its analysis

2.1. The Lower rule

Consider the basic pattern of vowel-zero alternations under (1) below.¹

(1)	open syllable				closed syllable			
	zero		vowel		vowel		vowel	
	C	C-V	C	C-ye C-ø	C	C-ø	C	C-CV
Russian	døn'-á		d'en'-ók		d'én'		d'en'-øk-á	
	vojøn-á				vójen		vojén-n-ij	
Czech	dom-øk-u		dom-eč-ek		dom-ek		dom-eč-øk-u	
	lokøt-e				loket		loket-n-í	
Polish	pøs-a		pies-ecz-ek		pies		pies-øk-a	
	diabøł-a				diabeł		diabel-n-y	

Did the grey-shaded column not exist, the alternants could be predicted according to syllable structure: a vowel appears in closed syllables (Cz *loket*, *loket.ní*), while zero occurs in open syllables (Cz *lokø.te*). The grey-shaded column shows, however, that alternation sites may also be vocalized in open syllables, and that this kind of vocalization occurs when the following vowel alternates with zero itself.

- (2) Alternation sites are vocalized in open syllables iff the following vowel alternates with zero.

Slavic languages thus make a difference between phonetically expressed vowels that do and those that do not alternate with zero: the

¹ Glosses: Russian 'day' Gsg, dim. Nsg, Nsg, dim. Gsg; 'war' Nsg, Gpl, adj.; Czech 'house' dim. Gsg, double dim. Nsg, dim. Nsg, double dim. Gsg; 'elbow' Gsg, Nsg, adj.; Polish 'dog' Gsg, double dim. Nsg, Nsg, dim. Gsg; 'devil': Gsg, Nsg, adj.

former provoke the vocalization of preceding alternation sites (Cz *dom-ec-ek*), which however remain unvocalized in the latter case (*dom-øk-u* and also *skel* ‘glass Gpl’ vs. *skøl-o*, *skøl-ov-it-y* ‘glass Nsg, glassy Nsg’, more on the latter example in section 5).

Lightner's (1965) insight was to generalize (2) to all cases where alternation sites are vocalized, that is to internal (*loket.ni*) and final closed syllables (*loket*): the vocalization observed must be due to the existence of a following yer. Therefore, all consonant-final words are assumed to end in yers underlyingly (e.g. in /lokĩt-ĩ/ where the final yer is interpreted as the Nsg case marker), and morphemes such as the adjective suffix *-n* are held to be yer-initial, i.e. /-ĩn/. In autosegmental terms, the difference between stable and alternating vowels is made through association (Rubach 1986): as shown under (3) below, the former are lexically associated, while the latter float.

(3) yers are floating pieces of melody: Rubach (1986)

a. lokøt-e Gsg	b. loket Nsg	c. loket-ní adjective
x x x x x	x x x x	x x x x x x
l o k e t e	l o k e t e	l o k e t e n í

These lexical representations are then transformed into surface forms by the (autosegmentalized) Lower rule, which is shown under (4) below.

(4) autosegmentalized Lower (Rubach 1986)

$$\textcircled{V} \rightarrow \overset{x}{\underset{|}{V}} / \text{---}C_0 \textcircled{V}$$

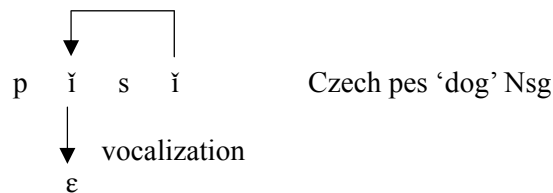
Yers, i.e. floating melodies, are circled. Lower associates a skeletal slot to a yer iff this yer is followed by a (number of) consonant(s) and another yer. Its cyclic application produces the attested surface forms. Namely, Lower will vocalize all members of a chain of yers save the last one: Polish /[[[pĩs] ĩk] ĩk] ĩ]/ comes out as *pies-ecz-ek* (more on this derivation shortly). Yers that remain unvocalized are then erased (or simply ignored by regular autosegmental conventions where floating melodies are not pronounced).

2.2. Government-based analysis

The Lower rule in fact describes a lateral relation between vowels: the only information that is needed in order to compute the phonetic value of alternation sites concerns the following vowel, which is either a yer (i.e. a floating piece of melody) or a non-yer (an associated piece of melody). In the former situation the alternation site is vocalized (i.e. the floating melody receives an x-slot), in the latter it is not.

Also, the intervocalic communication at hand is regressive (right-to-left) in the sense that the patient is the leftmost vowel, whose phonetic value is determined by its neighbour to the right.

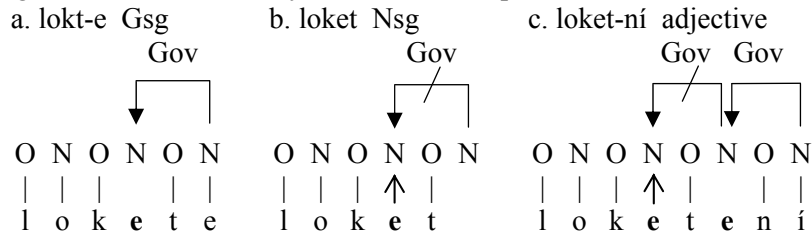
- (5) Lower describes a lateral and regressive relationship between vowels



The ingredients of Lower are a striking match of tools that have been developed in (Standard) Government Phonology (Kaye et al. 1990, Kaye 1990a) on entirely independent grounds (see Scheer 2005). The lateral relation that is described by Lower is called government in this theory, and government inhibits the segmental expression of its target. Whether or not a government relation between two neighbouring vowels goes into effect depends on the phonetic properties of the head: only phonetically expressed nuclei are good governors of floating melodies. That is, the final empty nucleus under (6)b cannot govern, a fact that causes the lexically floating melody of the preceding nucleus to associate: *loket*. By contrast under (6)a, the case marker *-e* sits in the final nucleus of the word, which is therefore able to dispense government. As a consequence, the preceding floating melody does not associate: *lokøt-e*. Finally, under (6)c, the rightmost yer does not associate since its nucleus is governed by the following full vowel. Being phonetically unexpressed, it is therefore

unable to govern its lefthand neighbour, whose floating melody associates: *loket-~~on~~-í*.²

(6) government-based analysis of the Lower pattern



On this analysis, government acts as an association-inhibitor: stable vowels are lexically associated, while alternating vowels are floating pieces of melody; these associate by default, except when their nucleus is governed. Or, in other words, floating melodies can only associate to ungoverned nuclei.³ Also note that final yers have disappeared: there is no floating segment following word-final consonants anymore. Its function is taken over by final empty nuclei (which in Government Phonology follow all word-final consonants in all languages). In this perspective, the fact that final yers never appear on the surface is explained by the melodic emptiness of final empty nuclei: only those nuclei that really host an alternating vowel which sometimes appears on the surface possess a floating piece of melody.

2.3. Yer chains

Let us now look at how the government-based analysis reacts on yer chains, i.e. forms with several yers in a row. Recall that the standard analysis proceeds cyclically: Polish /[[[přs]řk]řk]ř]/ is successively transformed into *pies-ecz-ek* ‘dog, double dim. Nsg’ by following the morphological structure from inside out. After the root cycle (where nothing happens), [přřk] is computed; the yer in the root is vocalized

² The adjective suffix *-n* (or its equivalents in other Slavic languages) is traditionally considered to be yer-initial. Evidence for the yer comes from short adjective forms: compare e.g. Cz *nemoc-en* (short form) with *nemoc-~~on~~-ý* (long form) ‘ill, masc. Nsg’.

³ Note that like in Rubach's (1986) standard autosegmental analysis, there is no restriction on the melody of floating vowels: any vowel could in principle be floating and hence alternate with zero.

since it is followed by another yer: [piesĩk]. On the next cycle, [piesĩkĩk] is considered, and again the leftmost yer is vocalized: [piesekĩk]. This output is then the input to the last cycle, where [piesekĩkĩ] is examined and the leftmost yer again vocalizes. The result of the derivation is thus *piesieczek* (after the (stray) erasure of the final yer).

The government-based analysis works along the same lines. First consider the lexical representation of the diminutive suffix *-ek*, as well as of the root *pies*.

- (7) a. root *pies* ‘dog’ b. diminutive *-ek*
 O N O N O N
 | | |
 p' e s e k

Following regular phase theory (which is but a procedural recast of the representational cyclic derivation where all morphemes are present when phonological computation begins), suffixes are merged progressively, which means that the root is first assessed by itself. The floating E of the root [p'E \emptyset] associates: its nucleus escapes government because the final nucleus is empty (\emptyset) and hence unable to govern. The merger of the first *-ek* then produces [piesEk \emptyset], and the floating melody again associates for the same reason. This procedure is repeated on the last cycle when the second *-ek* is merged: [piesekEk \emptyset] \rightarrow *pies-ecz-ek*.

The classical and the government-based analyses are thus equivalent for the time being. We will see below that the Havlík pattern is able to tell them apart.

3. The Havlík pattern

While Lower controls modern languages, the appearance of alternating vowels obeyed a slightly different rule in Old Czech (OCz) and Old Polish (OPol). The difference concerns precisely sequences of alternating vowels: while languages that follow Lower vocalize all alternating vowels in a row (MoCz /domEčEk/ appears as *domeček*), only every other alternating vowel surfaces (counting from the right edge) in languages where the Havlík pattern is found (OCz /domEčEk/ appears as *domøček*). This pattern was discovered in 1889 by Antonín Havlík in the

coat of a diachronic regularity when comparing Common Slavic (CS) to OCz (Havlík 1889).

(8) Havlík's Law

- a. In a sequence of consecutive yers in CS, every other yer appears in OCz, counting from the right edge.
- b. se psem 'with the dog'

4 3 2 1 4 3 2 1

CS sь pьs-ьmь > OCz se pøs-emø

On the basis of examples from OCz and OPol, table (9) below shows that the relationship between an alternating and a stable vowel in the following syllable is the same in systems where Havlík and Lower rule ((9)a), and both patterns also show the same reaction before word-final consonants ((9)c) and consonant clusters ((9)d). It is only the relationship among alternating vowels that differs ((9)b): while a phonetically realized alternating vowel behaves just like a stable vowel under Havlík (it causes the absence of a preceding alternating vowel), it acts as if it were not there under Lower (i.e. the preceding alternating vowel is vocalized). The table below shows examples from OCz and OPol (see e.g. Rospond 1979:74 for the latter).

		open syllable		closed syllable	
		a. zero C__C-V	b. vowel/zero C__C- <i>yer</i> C	c. vowel C__C#	d. vowel C__C-CV
Czech	Mod. Old	dom- ø k-u	dom-eč-ek dom- ø č-ek	dom-ek	dom-eč- ø k-u
Polish	Mod. Old	pies- ø k-a	pies-ek pøs-ek	pies	pies- ø k-a

Diachronic grammars typically report that Havlík's Law correctly describes the state of affairs in the old languages which continue CS, but that "secondary vocalizations" have disturbed the picture since then. That is, CS odd numbered yers which are weak and have fallen out due to the action of Havlík's Law are "restored" in certain modern languages under analogical pressure. Regarding Czech, Liewehr (1933:98), Trávníček (1935:47) and Komárek (1969:48) for example argue along these lines.

This analogy-based scenario cannot be correct. For one thing, there were no CS yers left in OCz that could be restored. Also, analogical activity is typically erratic throughout the lexicon. The shift from Havlík to Lower, however, affected one hundred percent of the lexical items and today is completely regular.⁴ Also, it occurred simultaneously in Polish and Czech.⁵

Finally, a number of languages beyond Slavic also follow the Havlík pattern: Moroccan Arabic (Kaye 1990b), German (e.g. Hall 1992, Noske 1993) and French (Scheer 2004:§469, Schenker 1995:97 is explicit on the Slavic-French parallel).

There is thus certainly reason to believe that Havlík and Lower are two parametric possibilities of how the relationship between two alternating vowels in a row can be handled. As far as we can see, the two options exhaust the parametric variation that can be found regarding the vocalization of alternation sites across languages (a variation of another kind regards the optional vs. obligatory character of the alternation).

4. Analysis of the Havlík pattern

4.1. *The non-cyclic application of government produces Havlík*

Let us first look at how the government-based analysis handles the Havlík pattern. In order to derive the correct result, all that needs to be done is to apply government non-cyclically, i.e. to the entire sequence of alternating vowels in one go. An input string such as [domEkEkø] will be computed from right to left since, recall, government is defined as a regressive relationship: the status of the rightmost nucleus of a phase needs to be determined first because the status of all others depends on it.

Final nuclei of input strings to phonological computation being thus computation-initial, E₁ in [domE₂kE₁kø] will vocalize since the string-final nucleus is empty (ø). Being associated, E₁ is a good governor and therefore governs E₂, which for that reason does not associate. Were there another alternating vowel to the left of E₂, it would be vocalized since, being phonetically unexpressed, E₂ is unable to govern. The non-cyclic application of government thus derives the Havlík pattern

⁴ In Czech there is one single exception: *šev* ‘seam, Nsg’ (Gsg *šøv-u*) derives *šøv-ec*, not **šev-ec* ‘shoemaker’ (Gsg *šev-øc-e*).

⁵ For further arguments against the analogy-based analysis of the Havlík-to-Lower change see Ziková (2009).

where every other item of a yer chain vocalizes, counting from the right edge. In our example, the result is *domoček*.

4.2. Phase-triggering (cyclic) vs. phase-neutral (non-cyclic) affixes

In this perspective, the difference between Lower and Havlík is simply the cyclic (Lower) vs. non-cyclic (Havlík) processing of the string. At least since Halle & Vergnaud (1987) (but in actual fact since SPE and classical Lexical Phonology where affix classes were recognized, cf. Kiparsky 1982), whether a derivation is cyclic or not is determined by the affix that is concatenated. Affixes thus fall into an interpretation-triggering (cyclic) and an interpretation-neutral (non-cyclic) group (see also Kaye 1995).

On the syntactic side, Phase Theory and Phase Impenetrability lie at the heart of current minimalist syntax (Chomsky 2000, 2001 et passim). Syntactic structure is processed piecemeal so that workbench memory is unburdened: at given points in the syntactic derivation (phase heads), interpretation is triggered and the current string is sent to PF/LF. In this environment, cycles are called phases, and affixes may be phase-triggering or phase-neutral (see Scheer 2008, forth).

A suffix such as the diminutive *-ek* was thus non-cyclic in OCz. That is, it did not trigger any interpretation upon concatenation and produced the string [domEkEkø] without internal cyclic structure; in syntactic terms, this string represents one single phase. The suffix *-ek* then became cyclic in diachronic evolution, which means that a cycle is created upon concatenation or, in syntactic terms, interpretation is triggered upon concatenation and the string has three phases: [[[dom] Ek] Ek]. This phase-based scenario is argued for by Ziková (2008, in press).

4.3. Spell-out your sister!

Finally, note that the phase-based analysis requires a specific way of triggering interpretation: the string that is computed upon the merger of a phase-triggering affix is the *sister* of the affix (i.e. the root in [[pEs] Ek]). This is indeed the way Kaye (1995) and minimalist phase theory organize cyclic spell-out: given an XP that is a phase head, only the complement of this XP is sent to computation upon the spell-out of the XP; the head and the specifier, which are called the phase edge, are spelt out only at the next higher phase (Chomsky 2000:108). Hence like in phonology, the sister of the head of a phase head is sent to computation.

This is not a trivial question since Halle & Vergnaud (1987:77ff) for example hold that the entire phase head, i.e. the affix together with the item to which it attaches, is a computational unit: in our example, Halle & Vergnaud would send the entire string [pEsEk] to computation upon the merger of interpretation-triggering *-ek* to the root *pies*. It was shown above that this produces the wrong result in Slavic: in order to derive the Lower pattern, the cyclic derivation must follow the "spell-out your sister" option (more on this issue in Scheer 2008, in press).

4.4. The Lower rule cannot capture the Havlik pattern unless it is made directional

The generative literature does not consider the Havlik pattern and its relationship with the Lower pattern: we are not aware of any relevant statement (see Scheer 2004:§468), except for Rubach (1984:190), on which more below). It is therefore difficult to determine what an analysis in terms of the classical Lower rule or OT-adapted versions thereof would look like. It should be kept in mind that the government-based analysis *is* a version of Lower, as was shown. One thing that it contributes and which is absent from the original Lower rule, though, is directionality. It was mentioned that government is defined as a head-final lateral relation; strings are therefore processed from right to left. This is a general characteristic of government that owes nothing to Slavic languages or yers.

By contrast, the original Lower rule does not provide any indication whether a given string should be processed from left to right, from right to left or in any other way. It is therefore unclear how the Lower rule should be applied when a string needs to be processed that makes a single cycle/phase and contains more than two alternating vowels in a row: in a string such as *CĭCĭCĭ#*, which is the (first) yer that the Lower rule should apply to?

Rubach (1984:190) implicitly admits that Lower by itself, i.e. when unmarshalled by morphological (cyclic) structure, applies from right to left: "Havlik's Law states that Lower used to apply from right to left vocalizing even numbered yers and not from left to right. [...] The change of directionality comes as a surprise in a noncyclic framework. In our theory this change follows automatically from the fact that Lower became a cyclic rule".

Rubach's short remark on the Havlík pattern did not have much echo or influence on practitioners of the Lower rule, whose intrinsic directionality is never mentioned. His scenario, both synchronic and diachronic, though, turns out to match exactly the government-based solution (or rather, the latter joins the former).

The insight when Rubach's remark and the government-based analysis are merged is thus that 1) Slavic vowel-zero alternations are the product of an internuclear relationship that is 2) regressive and hence parses strings from right to left (which kind of strings are submitted for computation is decided independently).

In addition, the government-based perspective holds that the same regressive internuclear relationship is also active beyond Slavic, i.e. controls vowel-zero alternations wherever the Havlík pattern is found. A mechanism that is reputed to be specifically Slavic thus turns out to be an instance of a more general theoretical tool. That is, making the regressive character of Lower explicit offers a perspective for a general and unified theory of vowel-zero alternations.

Finally, this perspective also extends beyond vowel-zero alternations: vowels that alternate with zero may or may not have the same bearing as stable vowels on processes that affect preceding vowels. Vowel-zero alternations are just one possible instantiation: Scheer (2004:§428) has collected a number of relevant examples beyond this specific process that include vowel length (in Western Slavic) and ATR alternations of mid vowels in French.

5. Association under control

An ingredient of our analysis of the Lower and Havlík patterns is the fact that suffix-initial vowels are floating pieces of melody (see (7)) that end up in the final empty nucleus of the preceding morpheme upon concatenation. Hence /pEsø/ and /-Ekø/ produce *pies-Ekø* whereby the suffixal E parachutes into the root-final nucleus upon concatenation.

This analysis runs into trouble, though, since it cannot distinguish between suffix-initial vowels that alternate with zero (such as in *-ek*) and suffix-initial vowels that do not alternate such as in, say, the Polish adjective suffix *-ow*. The properties of *-ow* may be inspected on the occasion of words such as *kotł-ow-y* 'boiler, adj. Nsg': the *o* provokes the absence of the preceding alternating vowel (cf. *kotł-a*, *kociol*

‘boiler Gsg, Nsg’) and hence must sit in the final empty nucleus of the root. That is, it must float in the lexical representation of the suffix, just like the *e* of *-ek*.

On the other hand, the *o* of *-ow* must be lexically associated since it does not alternate with zero itself (cf. *kotl-ow-y*): the agreement marker *-y* sits in the final empty nucleus (it governs preceding alternating vowels, cf. *pet-en* and *pet-~~en~~-y* ‘full, short/long form’) and is thus lexically floating like all other suffix-initial vowels. However, it fails to provoke the absence of the *o* in *-ow*: **kociot-~~ow~~-y*.

Now recall from section 2.1 that the alternating vs. non-alternating character of vowels is expressed by their floating vs. lexically associated status. This means that the vowel of *-ow* requires to be granted self-conflicting properties: it needs to be both floating (because it ends up in the final nucleus of the root) and lexically associated (because it does not alternate with zero).

Ziková (2008) therefore proposes that floating vowels come in two varieties: one is lexically specified for associating to any empty nucleus no matter whether the target of association is governed or not; the other can only associate to ungoverned nuclei. This is depicted under (10).

- (10) a. alternating suffix-initial vowel b. non-alternating suffix-initial vowel
- | | | | | | | | | | | | | | | | | | | | | | |
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| o | w | | | | | | | | | | | | | | | | | | | | |
- ↙

On this count, floating vowels are always eager to associate. The properties of the nucleus to which they can associate, however, are lexically specified: some (as under (10)b) associate no matter what, while the association of others (as under (10)a) is restricted to nuclei that are ungoverned.

Note that this does not add any extra machinery to the grammar since the distinction between alternating and non-alternating vowels may now be recast in fully general terms: all alternating vowels (i.e. whether belonging to a root or to an affix) are floating and lexically specified for target-sensitivity (they can only associate to ungoverned nuclei), while

non-alternating vowels are either lexically associated or specified for target-insensitivity (they can associate to all nuclei).

This analysis is developed by Ziková (2008) for Czech, where the same pattern is found (e.g. *skøl-ov-it-ý* 'glassy, Nsg', cf. *skøl-o*, *skel* 'glass, Nsg, Gsg'). The idea that the association of floating melody may be under grammatical (or lexical) control is neither new nor outlandish: evidence to this end comes from French liaison (Encrevé and Scheer 2005), and also from the grammatical tradition of Semitic languages where morphemes often reduce to the "order" that is given to a specific piece of melody to associate (another case in Berber is reported by Ben Si Saïd 2009). In fact, target-sensitivity of association is nothing more than the formalization of a hitherto unexploited potential that is inherent in autosegmental representations.

6. Conclusion

Although a well-known pride of Slavic phonology, the Havlík pattern did not contribute to the generative analysis of vowel-zero alternations in the past. Following Rubach (1984:190), we have tried to show that the parametric variation between the Lower and the Havlík pattern requires a view of the classical Lower rule that is directional: Lower must apply from right to left. Only on this condition may the Lower-Havlík parameter be expressed as the simple difference between the cyclic vs. non-cyclic character of affixes. Directional Lower, however, is what is called government in Government Phonology: a regressive internuclear relationship whose head must be phonetically expressed and whose target is phonetically absent.

Conceiving of vowel-zero alternations in terms of directional Lower also offers the opportunity to depart from the Slavo-centric picture of yers which are held to be a specifically Slavic phenomenon. Slavic vowel-zero alternations are not any different from vowel-zero alternations in other languages. The same regularity, i.e. the specific Lower context, also controls other alternations in and beyond Slavic. There is thus reason to conceive of the original Lower rule in terms of a more general mechanism that is neither specific to vowel-zero alternations nor to Slavic.

Finally, our analysis introduces the possibility for floating chunks of melody to be lexically specified for their behaviour during phonological

computation: they may either be specified to associate only to certain targets (ungoverned nuclei), or to be able to attach to any constituent. Placing association under control (rather than having it apply automatically) takes advantage of an inherent potential of autosegmental representations.

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⁶ References followed by WEB are available at www.unice.fr/dsl/tobias.

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