

The grid of the French syllable

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0. Summary

In this article it is argued that phonological relations can best be represented by bracketed grids (Halle and Vergnaud 1987).¹ The elements of a syllable have a linear relationship to each other and grids are a better formalism to express this than trees. In section 1, an abstract definition of government is given. It is argued that the concrete realization of this notion is different in phonology from the one in syntax. In section 2, we specify a theory of the syllabic grid, which is demonstrated with an analysis of French syllabification in section 3 and subsequently applied to the facts of French liaison in section 4. It is claimed that an explanation of these facts based on grids is superior to one based on trees.

1. Government

The rules in a component of grammar work on certain representational structures, like trees in syntax or grids in metrical phonology. The inherent nature of these representations constrains the possible output of the rules. There are no rules which derive a tree with two root nodes or a grid which violates the Continuous Column Constraint (Hayes 1991).

We are not concerned with the phonological rule system here (cf. Bromberger and Halle 1989) but we will look at one very general linguistic constraint which occurs in many components of the grammar and can informally be stated as follows: *a certain element β may only occur if there is an element α nearby*. Examples of this are anaphors (β) and antecedents (α), consonants (β) and vowels (α) or stressed (α) and unstressed (β) syllables in a Perfect Grid (Prince 1983). We could tentatively call this general constraint schema *government*, and say that β is a governee and α is a governor if the following conditions hold:

¹ Thanks are due to Clemens Bennink, Ben Hermans, Roeland van Hout and the LIN-reviewer for comments and discussion. I alone am responsible for all errors and misrepresentations.

(1) *Government* α governs β iffa α is a head of type Hb β is near α , where *nearness* is a binary relation of type N.

H and N in this definition are variables. In syntactic government, H is filled with the content of 'syntactic head', i.e. α has to be a member of {A, N, P, V, AGR, T} in head government, or it has to have a certain index in the case of antecedent government (Rizzi 1990). Whether a particular category is a head of a certain type or not depends on its syntactic features. In phonological government the definition of headedness could likewise refer to phonological features, so to subsegmental structure. It might seem at first sight that N is always a command-relation, or at least defined in terms of trees. I believe this claim is valid for syntax, but for phonology it is mistaken.

Aoun (1979) was the first one to propose that notions like 'head' and 'government' play part in phonology as well as in syntax. Let us turn our attention to one specific implementation of this idea, viz. the tree-based syllable theory of Kaye, Lowenstamm and Vergnaud (1990, henceforth KLV). There are basically two possible government relations between the x-slots constituting onsets and rhymes within this theory. These are called *constituent* and *interconstituent government*. We give the KLV definitions in (2) and (3) respectively.

(2) *Constituent government*

A syllabic constituent is a governing domain, where the government relation is defined as

a strictly local [i.e. subject to adjacency requirements]

b strictly directional: head-initial

(3) *Interconstituent government*

Interconstituent government is

a strictly local [i.e. subject to adjacency requirements]

b strictly directional: head-final

KLV note that from these definitions it follows that '*governing relations may exist between contiguous skeletal positions.*' They also note that from (2) it follows as a theorem that phonological constituent trees are bipositional only. However, since no explicit reference to hierarchical structure is made in these definitions, it is not sure that trees are needed at all to account for government.

Moreover, according to (2b) and (3b) *precedence* plays an important role in phonological nearness, whereas this relation does not take part in any type of syntactic government as defined in e.g. Rizzi (1990). This leads us to the following conjecture. (We use '<' and '>' as operators indicating precedence

relations, ' \sim ' is used for linear adjacency; as a matter of course, both ' $>$ ' and ' \sim ' can be derived from ' $<$ ' (cf. footnote 2)).

- (4) *phonological* government is defined in terms of precedence relations ($N = \{<, >, \sim, \dots\}$)
syntactic government is defined in terms of dominance relations ($N = \{m\text{-command}, c\text{-command}, \dots\}$)

If this is right and c-command (hence dominance) does not really play a role in the theory of government relations within the syllable, *trees* seem to be no adequate means for representing these relations. Phonology, then, is different from syntax not only because it has a different type of derivational (rule) system, but also because it uses a different type of relations. There are some resemblances between syntactic and phonological government, but these are very abstract (cf. (4)). The interpretation of phonological notions like 'head' and 'government' is rather different from their counterparts in syntax. As an alternative to trees for interpreting phonological government, we can consider grids. Grids are designed to represent precedence relations. Moreover, from Halle and Vergnaud (1987) we know that 'head' and 'government' can be interpreted in terms of grids. We will explore the idea that grids give the right interpretation for subsyllabic government.

2. The syllabic grid

Senufo is a language spoken in Côte d'Ivoire. It has CV syllables only (Clements and Keyser 1983). We can easily describe the syllable structure of this language in terms of grids. The Senufo word *senufo* could be represented as follows.

(5)	.	x	.	x	.	x		syllabic line (\rightarrow , PG)
	x	x	x	x	x	x		x-slot line
	s	e	n	u	f	o		

The syllabic line can be seen as the basis for normal metrical grids, like Halle and Vergnaud's (1987) *line 0*. We assume that *dots* ('.') in a line -elements that do not project to a higher level- must be governed by *stars* ('x') -elements that *do* project to a higher level. This means that the content of the predicate 'being a head' in metrical phonology is 'being a star'. There is one lowest line, the x-slot line, on which all elements are stars. Every other line is a subset of the line immediately below it. A grid is a collection of such lines. I follow Halle and Vergnaud (1987) in not taking the relation of an element to its projection on another line to be a government relation.

It is defined on every line which type of phonological government relation holds on that line. The most relevant types of government relations for the

present discussion are left adjacency (denoted by a leftward arrow \leftarrow), right adjacency (\rightarrow) and the Perfect Grid (PG). These relations can be trivially defined in terms of the ' \prec ' operator.² Left and right adjacency speak for themselves, but the Perfect Grid is nontrivial. We give an informal definition in (6).

- (6) *Perfect Grid*: Dots have to be X-governed. Governors may not be governed, (where $X \in \{\rightarrow, \leftarrow, \sim\}$)

PG is government with H = 'being a star', N = 'being (left or right) adjacent' with the addition that governors cannot be governed. This is not very deviant from current syntactic practice. Case governors (like verbs) may not appear in a case governed position. The reason why we want to say that the PG requirement holds as an extra condition on the syllabic line, is that it is in general impossible to have an onsetless syllable inside a word. In the word *piano* we have to insert a glide to get [pijano], because otherwise we would have two vowels (or two stars) adjacent to each other. The right one of these would govern the other. This possibility is excluded by the Perfect Grid (cf. Prince 1983).

Our system now works perfectly for languages with just CV syllables, (where we can say that ' \rightarrow government' has to hold along with PG, because C's appear to the left of V's) but not for languages with a more complex syllable structure. Consider the English word *cry* for example.

- (7)
- | | | | | |
|---|---|---|--|--|
| . | . | x | | |
| x | x | x | | |
| c | r | y | | |
- syllabic line (PG, \rightarrow)
 x-slot line

The first dot on the syllabic line is not adjacent to a star. Hence we incorrectly predict this structure to be out. We could relax the government requirement to direction only (and leave out adjacency). But in that case we would also predict the non-word **rcy* to be correct in English.

- (8)
- | | | | | | | |
|---|---|---|---|---|---|--|
| . | . | x | . | . | x | |
| x | x | x | x | x | x | |
| c | r | y | r | c | y | |
- syllabic line (\succ)
 x-slot line

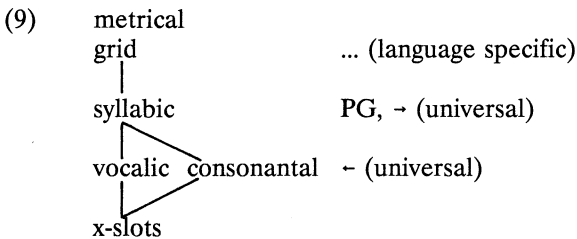
In some versions of phonological theory it is assumed that there is one central line, the line of x-slots, to which all features are linked. In stead of this one-dimensional skeleton, we adopt a two-dimensional one. This is a *grid*. Seg-

² $\alpha \succ \beta$ iff $\beta \prec \alpha$
 $\alpha \sim \beta$ iff $\alpha \prec \beta \wedge \exists \gamma: [\alpha \prec \gamma \prec \beta]$
 $\alpha \rightarrow \beta$ iff $\beta \sim \alpha$
 $\alpha \sim \beta$ iff $\alpha \sim \beta \vee \alpha \rightarrow \beta$

We say that α 'governs' β (β 'is < governed by' α) iff α is a head and $\alpha \prec \beta$

mental features are assigned to elements on one designated line of the grid. For example, in English, sentence pitch accent is assigned to the highest line of the sentence grid. All features that adhere to word accent are assigned to the highest level of the word grid.

Now in a way all these stress-related features are typical for vocalic elements. The highest element in a grid is the most 'vowel-like'; it has stress, pitch, emphasis, etc. At the same time, there also is a mirroring consonantal system in which the highest element is the most 'consonant-like'. The vocalic system and the consonantal system share their starting point, which we call the x-slot line and they also end at one single higher level, which is the syllabic line we discussed above. We then get the following skeleton.



The vocalic system is much more complex than the consonantal system. The vocalic system has at least three lines (vocalic, syllabic and the lines of the metrical grid), but the consonantal system has only one (the consonantal line itself).

Although it is not true that the vocalic line is exclusively for vowels, or the consonantal line for consonants, *vowels* prefer to project to the vocalic line and *stops* prefer to project to the consonantal line. In most languages we have one exceptional situation in which these elements can appear at the opposite line, viz. if their neighbour to the right has equal or better vocalic or consonantal qualities. For the obstruents, this can be informally represented by the filter (10) (which is equal to Vennemann's (1988) Syllable Contact Principle). We remain silent on the question whether (10) is a universal principle, or subject to parametrization.³

- (10) A stop may only project to the vocalic line, if it is left-adjacent to another stop, which is projected to a star on the consonantal line.

It has been shown (by Vennemann) that (10) does better than the competing Maximal Onset Principle in determining syllable boundaries. Notice that this

³ Italian, a language which normally only allows for sonorants in the rhyme, makes an exception for the 'first half' of a geminate obstruent, so that for this language we would have to formulate (10) somewhat more precisely.

principle excludes tautosyllabic obstruent clusters. It remains to be shown what can be said with regard to actual clusters of this kind.

A similar filter can be provided for vowels. The filters then refer exclusively to the outer ends of the 'sonority hierarchy'. There are also hybrid elements, like liquids and nasals which are more free to occur in one dimension or the other. These filters are realizations of the intuitive idea that elements at the outer ends of the hierarchy can only appear in a 'foreign' dimension if it is left-adjacent to something which has more (or equal) right to be on its 'own' dimension.

The principle in (10) explains the difference between *wodka* and *water*. The [t] in *wodka* is allowed to project into the vocalic plane of the first syllable because it is followed by the stop [k] (which itself is a star on the consonantal plane). The same does not apply to the [t] in *water*, however. This segment can only appear in the consonantal plane of the second syllable.

3. The French syllable

We will now turn our attention to Modern French (which is studied in KLV's framework by Charette 1991). The reader has probably noticed that we use a sonority scale to describe the relevant subsegmental structure (or a more formal feature theory from which the sonority effects can be derived, cf. Clements 1992). We give a simplified version of the scale in (11) (simplified in that certain classes are left out for clarity of presentation).

- (11) *Sonority scale* (simplified)
- | | | |
|---------|---|-----------------------------|
| vowels | } | vocalic line |
| glides | } | vocalic or consonantal line |
| liquids | } | vocalic or consonantal line |
| stops | } | consonantal line |

We abstract away from the many complications that nasals pose in Romance languages. Vowels in French prefer to appear at the vocalic line, obstruents at the consonantal line and liquids and glides are relatively free. Apart from this, if two elements are adjacent at the x line, and both project to the same line, the most 'consonantal' one is a star at the consonantal line and the most 'vocalic' one is a star at the vocalic line.

These principles interact to get the following structure for a word like *parti*. (In the following, I will use brackets as a notational means to indicate government domains, not as a new symbol available for rule application).

(12)	(.			x)	stress (>)	
	(.	x)		(.	x)	syllabic line (PG, -)
		(x		.)	x	vocalic line (-)
	x			x		consonantal line (-)
	x	x	x	x	x	x-slot line
	p	a	r	t	i	

The [p] and the [t] project to the consonantal line, where they are heads because there are no adjacent 'more consonant-like' elements. The [a], [r] and [i] project to the vocalic line. The [a] and [r] are adjacent at the x line and have to be compared with respect to vocal quality; [a] 'wins' because it is higher on the sonority hierarchy, hence [a] is a star and [r] a dot. Now all stars on the vocalic line and the consonantal line project to the syllabic line. Since this line is part of the vocalic system, vowels project to stars and other elements to dots. On top of the syllabic line is the stress system. In French we only have Prince's (1983) End Rule Right, represented by us with '> government'. This has as a consequence that all dots have to appear to the left of a star.

It can be seen that all government requirements are satisfied in this structure, in other words that this word is grammatical. We can also check that there is no alternative grammatical structure for *parti* in French. If the liquid would appear in the consonantal plane, it would be governed by [t], but in the wrong direction.⁴

Now we turn our attention to the structure of *patrie*. The arguments for [p], [a] and [i] remain the same. The interesting cluster is [tr]. Suppose the [t] projects to the consonantal and [r] to the vocalic line.

(13)	x		(.	x)	vocalic line (-)	
	x				consonantal line (-)	
	...	x	x	x	x	...
		a	t		r	i

x-slot line

At the vocalic line [r] projects to a point (because it is adjacent to the vowel [i]), but is not left-governed. But according to (11), [r] can also project to the consonantal line. Since it is adjacent to the more consonant-like [t], it projects to a dot there. We then end up with the following structure.

⁴ The reader may wonder whether it could not be governed by [p]. However, because of a phonological implementation of Relativized Minimality (Rizzi 1990), elements are governed by their nearest neighbour. This is [t], not [p].

(14)	(.				x)	stress line (>)
	(.	x)	(.		x)	syllabic line (PG, →)
		x			x	vocalic line (v)
	x			(x	.)	consonantal line (c)
	x	x		x	x	x-slot line
	p	a		t	r	i

The consonantal line in this system can be said to reflect the internal structure of a traditional Onset; the vocalic line represents the internal structure of the Rhyme.

4. The phonotactics of liaison

We will now discuss a difference of my approach to the theory of Charette (1991) with respect to French liaison.⁵ Consider the following data. (Following one of many traditions in the study of liaison we strike out a letter if the corresponding segment is not pronounced).

- (15) a un petit lapin - un petit ami
 'a small rabbit 'a small friend'
 b un grand lapin - un grand ami
 'a large rabbit 'a tall friend'
 c trop grand - trop âpre
 'too large 'too rude'

In the first column, the last segment is not phonetically realized. That it should be there at an underlying level can be seen in the forms in the second column. This problem is solved by Charette (1991) in the following way. The word *petit* is represented as in (16).

(16)	O	R	O	R	
	x	x	x	x	x
	p	e	t	i	t

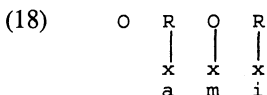
The [t] cannot be syllabified. It cannot appear in a new onset, because there is no element that can license a following rhyme (and words cannot end in a mere onset). It can also not appear as a coda in the preceding rhyme, because of the so-called '*Coda*' licensing principle.

⁵ I only discuss the phonotactic aspects of liaison, not the number of syllables, syntactic environment, sociological context and other variables in the study of liaison. Charette (1991) does not say anything about these subjects that could not be incorporated into my approach.

(17) 'Coda' licensing (Kaye 1990)

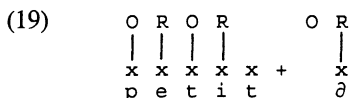
A non-nuclear point is syllabified within the rhyme iff there is a governor in the following onset.

Now there is no following onset after the last rhyme in (16), hence there is no governor. So the last [t] is not syllabified; for that reason it is not manifested phonetically. The word *ami* is represented as follows:



This word has an empty onset, because by stipulation all words start with an onset. In the construction *petit ami*, the floating [t] is syllabified into this empty onset.

In the feminine form *petite*, more or less the same happens. The feminine form consists of an empty syllable template OR. The rhyme of this empty syllable can be filled with a schwa, if wanted.



A word like *respect* is probably analyzed by Charette (1991) in the same way (although she doesn't discuss this actual example).



The [t] cannot be syllabified for the same reasons as we discussed above. But the [k] can also not be syllabified as a 'coda', because there is no licensing onset following as (17) requires. If we add the suffix *-ueux*, we get *respectueux*: the [t] is syllabified into an onset and according to (17), the [k] can now appear in the preceding rhyme.

So far the analysis may seem pretty elegant. Yet from the above it follows that if in French a word phonetically ends in a consonant, it always has a final schwa in the underlying representation. The same applies, according to Charette (1991), to words like *mer* 'sea', *cher* 'dear' and *bol* 'bowl', even though the final schwa in these words can under no circumstances be pronounced, not even before an *h aspiré*.

Apart from that, it is also not explained why there are no words ending on a liquid which do show the liaison alternation. Why is there no word like *rare* which surfaces as *raté* in *un objet rare* ('a rare object', masculine), but as *rare* in *une bouteille rare* ('a rare bottle', feminine)? We would have to make

the strange stipulation that all words ending in a liquid have an underlying final unpronounced schwa.

Matters grow even worse if we compare the *respeç/-respectueux* alternation to the pair *for/-forte*. How can the liquid in the latter pair be licensed, given the formulation of the Coda licensing principle in (17)? As far as we know, all words ending on a liquid+obstruent combination behave like *fort*. There are no words of the form **bo/-d-borde*. We do not see how this can be expressed in Charette's theory.

A last observation is that in modern French there are many (newly formed or borrowed) words like *fac(ulté)*, *vermouth*, *smoking*, *FNAC*, etc. Even though these words adapt to the rules of French phonology in other respects, their final obstruent is not deleted. They behave like *mer* except that they do not end in a liquid. As far as we know, practically all newly formed nouns behave like this. Within this same class, we even find forms like *direct*, in which the whole cluster [kt] is always pronounced (at least in some dialects). Yet there are no forms where the [k] appears phonetically, whereas the [t] isn't. This is contrary to what Charette (1991) would expect.

On the basis of the behaviour of these new forms, we assume that whether a word shows liaison or not is a matter of lexical specification. For this reason, we suppose that word final consonantal segments can be marked as *extrametrical*. If they have that marking, they can project to a dot at the syllabic grid without having to be governed.

With this feature, we can explain why newly formed French words like *fac* and *vermouth* do not show effacement of the last segment. The final segments simply are by default marked for extrametricality in the lexicon (like in some languages final syllables are by default marked as such), so that they can be represented as follows (extrametricality is graphically marked with angled brackets).

(21)	(. x) <.>	syllabic line
	x	vocalic line
	x x	consonantal line
	x x x	x-slot line
	f a k	

The final [k] here is not governed in the proper way (it is not left-adjacent to a star) but by definition it doesn't need to be because it is extrametrical.

The [t] of *petit* is not marked as extrametrical, so that the [t] cannot project to the syllabic line and therefore not to the the consonantal line. It also cannot project to the vocalic line, because there is no following obstruent (cf. (10)). Thus we get the following representation in which [t] is not syllabified. Like in Charette (1991), this means that it cannot be phonetically realized.

(22)	(. x)	(. x)		syllabic line
	x	x		vocalic line
	x	x		consonantal line
	x x	x x	x	x-slot line
	p e	t i	t	

However, if another element beginning with a vowel (like the feminine marker *-e* or the noun *ami*) follows the extrametrical element, the two grids are joined. It is well-known that we have liaison between a noun and a prenominal adjective, but not between an noun and a postnominal adjective, so this operation must subject to certain syntactic conditions (Kaisse 1985, Halle and Vergnaud 1987). But after joining the grids of *peti* and *ami*, a violation of the PG government relations at the syllabic level occurs, because two governors are in adjacent positions (this is impossible given the PG requirement, remember the discussion of [pɪjano] above). [t] has to project to the syllabic line in order to repair this violation.

(23)	(. x)	(. x)	(. x)	(. x)	syllabic line
	x	x	x	x	vocalic line
	x	x	x	x	consonantal line
	x x	x x	x x	x x	x-slot line
	p e	t i	t a	m i	

It can now be governed by the onset of the following word or morpheme, so there will be no ungrammatical result. We can explain all other liaison phenomena discussed above with this one single extrametricality feature. First, we can explain why words ending in a liquid (like *mer*) never show liaison phenomena. They are 'free' elements (cf. (11)) and they do not have to project to the consonantal line. Finally, also the *respect*, *direct* and *fort* cases no longer constitute a problem. They get the following analyses respectively. (We will not discuss the [sp] cluster in *respect*. Other analyses are possible, but this does not affect our main argument.)

5. Conclusion

We have argued that government relations within the syllable can better be expressed in terms of precedence. The best way of representing this type of relation is by means of grids. Furthermore we have seen that a grid-based theory plus a one extra stipulation (the independently needed device of extrametricality) has a better explanation for the facts of French liaison than its tree-based alternative of Charette (1991).

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