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**THE SYNTAX-PHONOLOGY INTERFACE
AND VARIABLE DATA: THE CASE OF
FRENCH LIAISON***

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In French, many word-final consonants are phonetically realized only when followed by a vowel-initial word. When followed by a consonant-initial word, they are erased. Hence, the opposition between *chez eux* and *chez lui*: in the first example the /z/ of *chez* is phonetically realized, in the second it is not. This phenomenon is currently known as French Liaison (henceforth FL). A brief discussion of the formal account of liaison is given in section 1 of this paper, where I will also discuss my assumptions about the organization of phonological rules (I will assume the theory of Lexical Phonology).

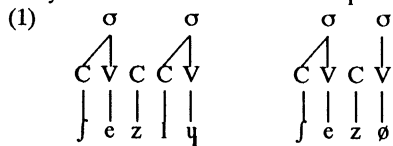
A first complicating factor about liaison is that it only occurs in specific syntactic or prosodic configurations. In section 2 of this paper I will argue that if liaison usage is to be accounted for in terms of a syntax-derived prosodic structure (of the type proposed in Selkirk 1986), a three-layered prosodic hierarchy must be assumed.

Another complicating factor is that liaison is a highly variable phenomenon. An advantage of our three layered account is that it can deal with at least a part of the variation pattern in liaison usage. In section 3 we will show, however, that other factors, such as syntactic category, word length and morphological information must be taken into account as well. We will explicitly take into account the possibility that the variation in liaison usage is lexical and due to lexical diffusion. It will be concluded that the influence of the prosodic hierarchy on the variation in liaison is a global one: it determines where lexicalization in liaison usage can take place.

A final complicating factor about French Liaison is that the data are not always clear (cf. Kaisse 1985: 163 and Morin 1987 for a discussion of this problem). Where necessary, we will use real speech data to corroborate our claims. Our data come from forty-five socially stratified interviews of the Orléans corpus (see Blanc & Biggs 1971 and Mullineaux & Blanc 1982) and are described in full detail in De Jong (1988) and De Jong (to appear).

1. Theoretical assumptions

I will follow Clements & Keyser's (1983) and Booij's (1984) proposal that liaison consonants in French must underlyingly be marked as 'extrasyllabic'. In Clements & Keyser's analysis *chez lui* and *chez eux* are represented as follows:



In this representation the /z/ of *chez* is not linked to a syllable tier (σ). When the second word is vowel-initial (as in *chez eux*), the phonetic realization of the extrasyllabic consonant is formalized via a convention which 'syllabifies' the extrasyllabic consonant by linking it to the following syllable tier. This linking rule is stated as follows:

(2) *French Liaison (FL)*



where C' stands for 'extrasyllabic consonant', and the dotted line indicates the association of C' with the following syllable node (σ). After the application of (2), the /z/ of *chez* is linked to the following syllable tier and will be phonetically realized. If the second word is consonant initial (as in the case of *chez lui*), the rule does not apply, the latent consonant does not surface phonetically and is erased at the end of phonological derivation.

I will assume the frameworks of Lexical Phonology (Kiparsky 1982, 1985, Mohanan 1986) and especially that of non-linear prosodic phonology (Kaisse 1985, Selkirk 1986, Nespor & Vogel 1986, Hale & Selkirk 1987). According to the former theory, at least two types of phonological rules must be distinguished: lexical rules that apply in the lexicon and postlexical rules that apply after the lexicon. Furthermore, lexical rules are subdivided in two types: cyclic rules and non-cyclic rules. The former interact with morphology, and the latter do not: they apply 'across-the-board', as the saying goes.

The organization of postlexical rules is elaborated in the theory of non-linear prosodic phonology. Postlexical rules too can be subdivided in (at least) two types of rules: rules that interact with the syntax and rules that do not. The former type of rules applies only in certain syntactic or prosodic configurations, whereas the latter applies, once again, across-the-board. FL is a rule of the former type: it interacts with the syntax. A first question to be answered is how such interactions can be formally represented. That is: what does the syntax-phonology interface look like?

2. *Prosodic Domains*

Selkirk (1986) formulates the domain of external sandhi rules like FL in terms of prosodic constituents. The latter are derived from the syntactic surface structure via a set of syntax-sensitive mapping rules. These mapping rules pick out the end of some kind of syntactic category as the end of a prosodic domain.

I will follow Selkirk's (1986: 385) claim that the relevant syntactic categories are those of the X-bar theory. More precisely, the *right* ends of syntactic categories are prosodic domain ends.¹ The important question, then, is which category or categories are designated as relevant in the syntax - phonology mapping of French.

Selkirk (1986) assumes that the right ends of major category phrasal heads (X) are the end of a prosodic domain in French. Within this domain liaison is obligatorily used. Selkirk (1986: 396) gives the following examples:

- (3) a. on m'a souvent **amené**] dans_un_énorme wagon]
 b. ces très_aimables_ **enfants**] en_ont_avalé]

In the examples under (3) a mapping rule picks out the (bold-faced) phrasal heads as prosodic domain ends, and inserts an end-setting (symbolized as “J”) after each of them. All material between two end-settings, then, is in a prosodic constituent (which Selkirk 1986 calls the Small Phonological Phrase) within which FL applies obligatorily (predicted liaisons are symbolized by “_”).

Two remarks are in order. First, though adjectives are usually considered as phrasal heads, prenominal adjectives are not. Independent motivation for this claim is given in Selkirk (1986: 395) and Nespor & Vogel (1986). My data corroborate this claim in the sense that liaison is indeed (almost) always used after prenominal adjectives. I will follow this analysis of adjectives here.

The second remark concerns the fact that only nouns, full verbs and adjectives (the non-prenominal ones) count as phrasal heads. This follows from the independently motivated (Selkirk 1984: 337) *Principle of the Categorical Invisibility of Function Words* (henceforth the *PCI*), according to which all function words are always 'invisible' for the phonological rules that are subject to it.

A problematic aspect of this analysis is that our data from the Orléans corpus show that liaison is not obligatory after all function words. Variable liaison is found (1) after prepositions, (2) after copulas, (3) after the passive auxiliary *être*, (4) after the perfective auxiliaries and (5) after the modal auxiliaries. After all other function words liaison applies obligatorily. This shows that the SPP is not the domain of obligatory liaison.

The five word categories after which liaison occurred variably within the SPP have a striking fact in common. On the one hand they are all function words and belong to closed syntactic categories (categories containing a small number of words only). In this respect they resemble the other function words. On the other hand, they can also all be analysed as phrasal heads. This is well known for the prepositions. For example, Jackendoff (1977) analyzes prepositions as heads that subcategorize for a nominal complement. This analysis also holds true for copulas, which can be considered as verbal heads that subcategorize for an XP complement. Recently, Guéron & Hoekstra (1988) have demonstrated that in French the passive auxiliary and the perfective auxiliaries must be analyzed as verbal heads that subcategorize for a VP-complement, and the modal auxiliaries as heads that subcategorize for a CP-complement.

The five syntactic categories after which FL applies variably have in common that they are all 'minor category heads'. In this respect they are syntactically different from the other function words (henceforth referred to as real function words), which are never phrasal heads and cannot take a complement. They are also different from major category heads (nouns, 'full' verbs and non-prenominal adjectives) in the sense that they belong to a closed syntactic category. These syntactic differences are reflected in phonological differences with respect to liaison usage: after real function words within an SPP FL applies obligatorily, after minor heads within SPP FL applies frequently, and after major heads followed by a complement FL can also apply, but does so quite rarely (frequency data from the Orléans corpus will be given below).

Under an analysis in terms of prosodic constituents, the observed differences in behavior can only be accounted for when several prosodic levels are distinguished. A first level, P1, can be derived via a mapping rule that picks out the right end of every head

(major or minor) as the end of a domain. The contexts thus derived will have in common that they consist of a 'real' function word and a following word, and that the extrasyllabic consonant is obligatorily realized. This is exemplified under (4), where the major and minor heads are bold-faced and the relevant liaisons are indicated by an underscore.

- (4) a. (ils_ont)(**été**)(**aidés**)(**par**)(des_enseignants)(**admirables**)
 b. (tu_sais)(**quand**)(ils_inviteront)(un_autre_grand_artiste)

For the derivation of the second level, P2, the same mapping rule applies, but this time it is restricted by the PCI, and only **major** category heads will be picked out as a domain end. Examples are given under (5) (the major category heads are bold-faced, and the liaisons realized at P2 are indicated by a bold-faced “_”).

- (5) a. (ils_ont_été_aidés)(par_des_enseignants)(**admirables**)
 b. (tu_sais)(quand_ils_inviteront)(un_autre_grand_artiste)

It should of course be noted that in this domain, liaison must somehow occur variably. I will return to the issue of variability in liaison usage in the next section.

Finally, there must be a third level of prosodic structure, P3, where liaison is also used, but much less often than at level P2 (in the Orléans corpus liaison was used in about 54.8% of the contexts at level P2, but in only 3.6% of the contexts at level P3 (see De Jong 1989: 43-5). Level P3 concerns inflected head - complement sequences (cf. Selkirk's 1974 X-Comp Rule). This domain can be derived via a mapping rule that picks out the right end of every maximal projection as the end of a domain (for further details of this mapping rule I refer to Selkirk (1986) and to De Jong (1989). Examples are:

- (6) a. (ils_ont_été_aidés)(par_des_enseignants_**admirables**)
 b. (tu_sais)(quand_ils_inviteront_un_autre_grand_**artiste**)

In summary, the frequency data from the Orléans-corpus indicate that three levels of derivation must be distinguished: FL applies more frequently at level P1 than at level P2, where it applies more frequently than at P3, thus yielding the implicational pattern P1 > P2 > P3. The full prosodic structure for both of our examples, then, is:

- (7) a. ils ont été aidés par des enseignants admirables
 P1: (X)()()()
 P2: ()()()
 P3: ()())
- b. tu sais quand ils inviteront un autre grand artiste
 P1: ()(X)()
 P2: ()()()
 P3: ()()()

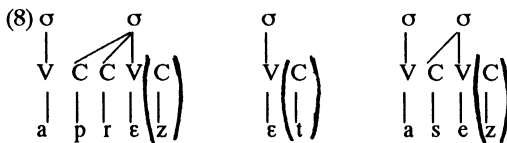
This three-layered prosodic structure² is based on the variation pattern for liaison as found in the Orléans-corpus as a whole, but it also holds good for individual data (see De Jong 1989). That is, for each individual we find the same implicational pattern P1 > P2 > P3. In other words, the prosodic hierarchy seems to determine at least a part of the variation in liaison usage.³

Nevertheless, the prosodic hierarchy is certainly not the only factor responsible for the variation in liaison usage. Things are quite a bit more complex than that, as I will try to show in some more detail in the next section. I will argue that the difference between the three prosodic levels is not only reflected in frequency differences in the application of FL, but also in varying degrees of syntactization, morphologization and lexicalization of liaison. At level P3 liaison applies only in some very specific contexts for which reference has to be made to syntactic, morphological and lexical information. This holds true for level P2 as well, but to a much lesser degree, whereas these tendencies are completely absent at level P1.

3. Variation

An as yet unanswered question is what exactly is varying when for one and the same word, all other things being equal, a speaker sometimes uses liaison and at other times does not. There are at least two possibilities. The first one is that the variation is postlexical. In that case it must be FL that applies variably on levels P2 and P3.

The other possibility is that the variation is lexical. In that case variation in liaison usage must be (1) a matter of variation in lexical entries or (2) in word-formation rules when the extrasyllabic consonant is a suffix. The former possibility must be interpreted in the sense that a speaker sometimes considers that one and the same word ends in an extrasyllabic consonant, and at other times that it does not. In other words, the speaker is not sure whether a specific word ends in an extrasyllabic consonant or not. The consequence of this uncertainty is that the extrasyllabic consonant is variably present. This can be notated as follows (for *après*, *est* and *assez*):



In (8) the brackets around the word-final extrasyllabic consonants indicate that it is a variable extrasyllabic consonant.⁴ If the speaker 'decides' that a word ends in an extrasyllabic consonant, it will be obligatorily realized at level P2 or P3. If the speaker makes the opposite choice, FL does not apply at level P2 or P3, simply because there is no extrasyllabic consonant to which it can apply.

The question thus is whether the variation in liaison is (a) a matter of postlexical variation in the application of FL, (b) a matter of lexical variation in the underlying form, or (c) a matter of both lexical and postlexical variation. I will try to provide some arguments showing that the variation is both lexical and postlexical.

I will first present some more frequency data on liaison. At level P2, liaison occurred in 54.8% of the contexts. Prosodic domains are cross-categorially derived from syntactic structure, so that, as said above, there should not be any significant differences in liaison usage after minor heads belonging to different syntactic categories. This cross-categorial aspect of the domain derivation, however, is strongly contradicted by our data, as is shown by the following table:

Category	L	N	%
1.Prep.	257	301	85.1
2.Etre	981	1728	56.8
3.Modals	41	132	31.1
4.Avoir	9	190	4.7
total	1288	2351	54.8

Table 1. *Liaison frequencies at level P2. L: absolute number of realized liaison consonants; N: total number of liaison contexts; %: percentage realized liaison consonants (adapted from De Jong 1988: 78).*

The data in table 1 show that liaison usage is highly dependent on the syntactic category of the liaison word. If Selkirk's (1986) model is assumed, such specific syntactic information is no longer available after the application of the mapping rules. Mapping rules as formulated by Selkirk cannot account for this cross-categorial variation, because after the application of the mapping rules, all syntactic information has disappeared.

But things are even worse than that: within each syntactic category we also find a high degree of variability in liaison usage between different words. This is illustrated by the following data for the prepositions:

item	Monosyllabic			item	Polysyllabic		
	L	N	%		L	N	%
<i>sans</i>	17	18	94.4	<i>après</i>	2	5	40.0
<i>dans</i>	187	199	93.9	<i>pendant</i>	1	11	9.1
<i>chez</i>	50	55	90.9	<i>devant</i>	0	3	0.0
				<i>depuis</i>	0	10	0.0
total	254	272	93.4	total	3	29	10.3

Table 2. *Liaison frequencies after prepositions (see table 1 for L, N and %) (from De Jong 1988: 88).*

These data show that liaison is very frequent after some prepositions, and quite rare after others. The display of the data suggests that liaison usage is dependent on word length, as has been claimed by several researchers (Encrevé 1983, Malécot 1979, Selkirk 1974). This effect of word length exists not only for the prepositions, but also for the other word categories at level P2, as shown in table 3:

Category	Monosyllabic			Polysyllabic		
	L	N	%	L	N	%
1.Prep.	254	272	93.4	3	29	10.3
2.Etre	934	1498	62.3	47	230	20.4
3.Avoir	9	80	11.3	0	110	0.0
4.Modal	35	98	35.7	6	34	17.6
Total	1232	1948	63.2	56	403	13.9

Table 3. *Liaison frequencies after monosyllabic and polysyllabic words after 4 word categories at level P2 (adapted from De Jong 1988: 75).*

Word category and word length are not the only factors interfering with the prosodic hierarchy. This becomes apparent from table 4, which provides information on liaison usage after the forms of the auxiliary / copula *être*:

item	Monosyllabic			item	Polysyllabic		
	L	N	%		L	N	%
<i>sommes</i>	21	29	72.4	<i>étaient</i>	6	20	30.0
<i>est</i>	784	1109	70.7	<i>était</i>	35	143	24.5
<i>sont</i>	76	153	49.7	<i>serait</i>	1	9	11.1
<i>suis</i>	47	156	30.1	<i>étais</i>	5	49	10.2
<i>soient</i>	2	7	28.6	<i>étions</i>	0	4	0.0
<i>êtes</i>	2	14	14.3	<i>seraient</i>	0	2	0.0
<i>soit</i>	2	28	7.1	<i>étiez</i>	0	1	0.0
<i>sois</i>	0	1	0.0	<i>serais</i>	0	1	0.0
				<i>seront</i>	0	1	0.0
total	934	1497	62.4	total	47	230	20.4

Table 4. *Liaison frequencies after the forms of être (from De Jong 1988: 92).*

Both within the subtables of the monosyllabic and polysyllabic items, we find a great deal of variation between the different forms of *être*. A part of this variation can be ascribed to the often noticed difference in behaviour between /t/ and /z/ liaison (Delattre 1966, Malécot

1979, Encrevé 1983). It should be noted that for verbs /t/-liaison marks third persons, and /z/-liaison first and second persons (see Morin & Kaye 1982, De Jong 1988), so that it can be argued that the variation has a morphological rather than a phonological status. On the whole, /t/-liaison is more frequent than /z/-liaison (see table 5).

Verb	%/t/	%/z/
être	61.2	36.5
modal	33.9	0.0
avoir1	16.9	0.0
avoir2	7.1	0.0
total	54.0	23.1

Table 5. *Liaison frequencies after verbs: /t/ vs. /z/-liaison. avoir1: main verb avoir; avoir2: perfective auxiliary avoir (adapted from De Jong 1988: 95).*

It is hard to see how the influence of such factors can be accounted for postlexically by Selkirk's model, where all syntactic information (Selkirk 1986: 373), but also all morphological and lexical information (as is claimed in Mohanan 1986, Kiparsky 1982, 1985) is erased after the application of the mapping rules. So after the mapping rules FL can no longer be restricted by lexical, morphological or syntactic factors. A possible way out is to set up a whole series of different mapping rules for each syntactic category, for monosyllabic and polysyllabic words, for first/second persons versus third persons, and maybe also for individual words. This, however, would be very much ad hoc and would yield an arbitrary and unwieldy number of mapping rules.

Another way out, however, is to relegate the variation to the lexicon. This is a not unattractive solution, because a closer look at the data allows for the hypothesis that at least a part of the variation in liaison usage is due to lexical diffusion. It has quite often been hypothesized that lexical diffusion is somehow related to word frequency (Phillips 1984). This seems to be the case for liaison as well, especially when it is realized that the often observed difference between monosyllables and polysyllables, and between /t/-/z/ liaison may reflect word frequency differences. Word length is closely related to word frequency: monosyllabic words are more frequent than polysyllabic words. Furthermore, third persons are much more frequent than first and second persons. In other words, in the more frequent (monosyllabic) words, word-final extrasyllabic consonants are maintained more often than the less frequent (polysyllabic) words, and the more frequent verbal suffix (the /t/) is maintained more frequently than the less frequent verbal suffix (the /z/).

I conclude that at least a part of the variation in liaison usage takes place in the lexicon, and has to do either (1) with variation in the lexical entry of a word or (2) with variation in the application of the word-formation rules that add the first, second or third person suffixes to the verb. On the one hand, speakers can have a variable underlying extrasyllabic consonant in the underlying representation of many words (see above). On the other hand, speakers variably suffix verbs for first, second and third person. The choice the speakers thus have is not a choice between the postlexical application of FL or not, but rather a

choice (1) between the presence / absence of an extrasyllabic consonant in the underlying form or (2) between the application or non-application of a word-formation rule in the lexicon.

But can all variation be lexical? Probably not. At level P2, this becomes apparent from the fact that after for instance the preposition *chez* the realization of the extrasyllabic *z* is dependent on the following word(s): it is categorical when *eux* or *elles* follow, but variable when an NP follows. Whatever the precise explanation for this phenomenon is, it clearly must be a postlexical one, because it refers to the syntax.

At level P3 a part of the variation must be postlexical too. This becomes apparent from the fact that liaison does occur after plural nouns when followed by an adjective, but not when followed by something else. Furthermore, liaison occurs after adjectives when they are pronominal, but not when they are in another syntactic position. In other words, there are some indications that the variation is both lexical (related to variation in underlying forms and word-formation rules) and postlexical (related to variation in the rate of application of FL).

In the light of the frequency data presented in this section, the role of the prosodic hierarchy seems to be more limited than can be concluded from section 2. It is only at level P1 that liaison is a truly prosodic rule: a rule applying in a prosodic domain. At that level the application of FL is exceptionless and truly cross-categorical. At level P3, however, liaison is highly syntacticized (for instance, applying in noun - adjective sequences, but not in adjective - PP sequences; i.e., reference has to be made to specific syntactic categories of various types), morphologized (FL applying only after *inflected* heads, for example after plural nouns) and lexicalized (for example in the Orléans corpus the only main verb after which FL applies at level P3 is the main verb *avoir*). At level P2, syntacticization, morphologization and lexicalization also occur (as shown by the data presented in this section), but to a much lesser extent than at level P3. This implies that at level P3, liaison is no longer a rule applying in a prosodic domain. The same is true for level P2, but to a lesser degree. In this sense, the role of the three-layered prosodic hierarchy seems to be limited.

It must be noted, however, that the prosodic hierarchy makes a very strong prediction about where, in what order and to what extent liaison usage syntacticizes, morphologizes and lexicalizes. Such processes will first (most often) occur at level P3 (where liaison also is the least frequent), then at level P2 (where liaison is much more frequent) and finally at level P1 (where liaison is most frequent). Thus the prosodic hierarchy is responsible for (at least a part of) the lexicalization and syntacticization pattern in liaison usage, and thereby for a part of its variation pattern. This is a not uninteresting claim, which certainly merits further research on the basis of related external sandhi phenomena in other languages (for instance Raddoppiamento Sintattico in Italian, see Nespor & Vogel 1986). Another area of research is historical linguistics. It is well known that variation patterns often reflect language change. If the proposed multi-layered prosodic hierarchy is of any value, then it predicts that changes in external sandhi rules will follow the prosodic hierarchy: they will first take place at the lowest level, and then gradually work themselves up to higher levels. This prediction is of importance for the patterns of change and variation in FL and Raddoppiamento Sintattico, but also for that of many syntax-sensitive 'variable rules' like /d/-deletion in English (Guy 1980) and Dutch (Van Hout 1989).

4. Conclusion

On the basis of frequency data on liaison usage in the Orléans corpus, I have proposed a three-layered prosodic hierarchy. This hierarchy accounts for at least a part of the variation pattern (and maybe also of the change) in liaison usage. Unfortunately, the proposed prosodic hierarchy cannot explain all variation. Another part of the variation in liaison usage is most likely due to processes of syntactization, morphologization and lexicalization of liaison usage. It appeared, however, that it is the prosodic hierarchy that determines where such processes take place.

NOTES

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1. The choice for a specific syntactic category as the end of a prosodic domain is set for each language by the Designated Category Parameter. The choice for left or right is set by the End Parameter (see Hale & Selkirk 1987).
2. The prosodic constituent at level P1 is very similar to Selkirk's (1986) Prosodic Word, that at level P2 to the Small Phonological Phrase, and that at level P3 to the Maximal Phonological Phrase. Furthermore, the representation in this example obeys the Strict Layer Hypothesis (cf. Selkirk 1984).
3. I assume that FL first applies at level P1. On the next cycle, P2, FL applies once again, and on the final cycle, P3, FL applies another time. In other words, our data provide an indication that syntax-sensitive, postlexical rules apply in a cyclic fashion.
4. This analysis is certainly not equivalent to Rotenberg's (1978) analysis of liaison in terms of 'partial suppletion' (see Encrevé 1988 for some discussion). Rotenberg notates a word like *les* as *le(s)*. The brackets around the final *s* of *les* indicate that for this word the long allomorph with *z* is used before vowel-initial words and the short one before consonant-initial words. Rotenberg's brackets do not refer to variability. Words showing categorical liaison (like *les*) are notated in the same way as words showing variable liaison (like *est*, *après*, *assez*).

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