FRENCH C/∅-ALTERNATIONS, EXTRASYLLABICITY AND LEXICAL PHONOLOGY

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1. INTRODUCTION

French is well known for its having consonants that alternate with zero, a phenomenon that has been widely discussed in generative phonology. In Clements and Keyser (1983) a new proposal is made to account for these alternations: in the underlying forms of morphemes, these consonants are marked as extrasyllabic, i.e. the syllabification rules of French cannot link them to a syllable-node. Hence, they will not surface phonetically unless they lose their extrasyllabicity due to the operation of some morphological or phonological rule.

In this paper I will argue that this analysis is a major improvement in comparison with both the standard analysis and the recently proposed analysis of Anderson (1982), which also takes syllabic structure into account.

However, as soon as we start working out Clements and Keyser's proposal in more detail, some non-trivial problems emerge, in particular with respect to rule ordering. It will be shown that the model of Lexical Phonology proposed by Kiparsky (1982) predicts some, but not all of the required orderings. Therefore, an important revision of the model of Lexical Phonology will be proposed: a distinction between a block of cyclic and a block of post-cyclic rules, both within the lexicon. This revised organization of phonology will be shown to make the correct predictions with respect to the interaction of the rules that are involved in the C/∅-alternations.

2. THE STANDARD ANALYSIS AND ITS PROBLEMS

In French we find C/∅-alternations at the ends of words in the following cases:

a. In derivational morphology, e.g. *petit* [pəti] 'small'/*petitesse* [pətitɛs] 'smallness', *respect* [rɛspɛ] 'respect'/*respectable* [rɛspɛktablə] 'respectable'.

b. In inflectional morphology, e.g. *petit* [pəti] 'small, masc. sg.'/*petite* [pətit] 'small, fem. sg.'; *je sors* [sɔr] 'I go out, pres.'/*sortir* [sɔrtir] 'to go out'.

c. In liaison-contexts. Liaison is the phenomenon whereby certain word-final consonants are realized only if the following word is vowel-initial and has a close syntactic relation to the preceding word (cf. Booij (to appear) for a discussion of the problem of how to define this domain).[1] Otherwise these consonants are not realized. Compare (the ‿ indicates liaison):

(1) petit‿ami [pətitami]   'little friend'
     petit garçon [pətigarsõ]   'little boy'
     il est petit [ilɛpəti]   'he is small'

There are at least three classes of consonants which alternate with Ø in liaison-contexts:

(i)   the final consonants of adjectives (as shown in (1)), as well as some adverbs and some prepositions, as illustrated in (2):

(2) dans‿une heure [dãzynœr]   'in one hour'
     dans deux minutes [dãdØminyt] 'in two minutes'
     assez‿important [asezɛ̃pɔrtã] 'important enough'
     assez patient [asepasjã]   'patient enough'

(ii) the final consonants of verbal inflectional suffixes. Compare:

(3) il vit‿en France [ilvitãfrãs]   'he lives in France'
     il vit dans le Maine [ilvidãləmɛn] 'he lives in Maine'
     vous chantez‿agréablement [vušatezagreabləmã]
                                      'you (pl.) sing pleasantly
     vous chantez mal [vušãtemal] 'you (pl.) sing badly'
                                      [from Tranel 1981: 161]

(iii) the plural suffix /z/ for nouns, adjectives and determiners:

(4) les‿enfants [lɛzãfã]   'the children'
     les parents [lɛparã]   'the parents'

les petits animaux [lɛptizanimo]   'little animals'
les petits crocodiles [lɛptikrɔkɔdil]   'little crocodiles'
les athlètes américains [lɛzatlɛtzamerikẽ]   'American athletes'
les athlètes français [lɛzatlɛtfrãsɛ]   'French athletes'

[from Tranel 1981:161]

In the theoretical framework of standard generative phonology these alter-
nations are accounted for in the following way (cf. Dell 1980):
— underlyingly the consonants are present;
— the consonants are deleted, unless they are followed by a vowel, either
  the initial segment of the following word (the case of liaison) or the
  initial segment of a following vowel-initial suffix;
— this consonant deletion rule is extrinsically ordered before a rule of
  schwa-deletion which deletes word-final schwa's, for instance those of
  the feminine forms of adjectives. Thus morphological schwa's serve to
  exempt word-final consonants from deletion.

Therefore, Dell (1980:157, 162) assumes the following phonological rules:

(5)   *Consonant Truncation*

$$[\text{-son}] \rightarrow \emptyset \; / \; \underline{\hspace{1cm}} \left\{ \begin{array}{c} \left\{ \begin{array}{c} + \\ \# \end{array} \right\} \quad C \\ \#\# \end{array} \right\}$$

(6)   *Final Schwa Deletion*[2]

$$\text{ə} \rightarrow \emptyset \; / \; \underline{\hspace{1cm}} \; C_0 \#$$

The rule of Consonant Truncation presupposes that + is the boundary
associated with inflectional morphemes, and # is the boundary between
two words in liaison-context. Otherwise, words are separated by two
##'s (Selkirk 1972, 1974).

The following sample derivations illustrate the workings of these two
rules:

(7)   petits amis 'little friends'   petit ami 'little friend, masc'

	#pətit+z#ami+z##		#pətit#ami##
TRUNC	∅	∅	----------------
S-DEL	---------------------		----------------
	[pətizami]		[pətitami]

petite maison 'little house'   petites épaules 'small shoulders'
    #pətit+ə#mɛzɔ̃##   #pətit+ə+z#epol+z##
TRUNC ------------------   ∅
S-DEL   ∅   ∅
     [pətitmɛzɔ̃]   [pətitzepol]

Although this standard account of the French C/∅-alternations is a nice demonstration of the descriptive power of generative phonology, it has several drawbacks, which can be summarized as follows:

(i)   The rules of Consonant Truncation and Schwa-deletion must be extrinsically ordered, in a counterfeeding fashion. An analysis without extrinsic ordering would be simpler, since ordering statements add to the complexity of a grammar.

(ii)   The rule of Consonant Truncation has many exceptions, words with a final consonant that is always realized, e.g. the nouns *flic, type, chef, pilote*, the adjectives *honnête, chique, vague, sec, énorme, fantastique*, the numerals *sept, neuf* and *onze* and the preposition *avec*. Dell (1980: 163) proposes to account for these exceptions by assigning them a final schwa underlyingly. This means that absolute neutralization has to be invoked.

(iii)   The standard analysis does not express the fact that in liaison the final consonant is tautosyllabic with the initial vowel of the following word.

From, among others, these observations and arguments Tranel (1981) draws the conclusion that the French C/∅-alternations mentioned above should be accounted for in a less abstract framework. He proposes that *a set of* consonant insertion rules be assumed instead of one rule of Consonant Truncation. Some of these insertion rules are morphologically governed, e.g. the rule that inserts a /z/ in liaison context after plural nouns and adjectives or the rule that inserts a /t/ in liaison context after 3rd pers. sg. pres. verbs.

It will be clear that the main problem for a consonant insertion approach is how to express the fact that the same consonant turns up in both the masculine form of an adjective in liaison context, its feminine form, and in words derived from that adjective. For instance, we find the same /t/ in *petit ami, petite* and *petitesse*. Tranel's solution is to assume the following rule of adjective liaison (Tranel 1981:239):

(8) $[+syll]_A, \; [+sg]$ # $_N [[+syll]$
                                        A

        1   2   3   → 1 2 C 3

That is, an empty consonant slot is inserted after the adjective. This C is inserted after the word boundary, because it is tautosyllabic with the following vowel. The rule for the feminine forms of adjectives and nouns (cf. *avocat/avocate* [avoka]/[avokat] 'lawyer, masc./fem.[1]) also inserts an empty slot, but in this case before the word boundary, because this C is tautosyllabic with the preceding vowel (Tranel 1981:251):

(9) X] # $\underset{A}{N}$ [+fem]

1   2 $\Longrightarrow$ 1 C 2

Tranel furthermore assumes that words such as *petit* and *avocat* have the following lexical representations, with an optional final consonant (Tranel 1981:238):

(10)   /pəti/   (/t/)   /avoka/   (/t/)

These optional consonants are supposed to fill the empty slots introduced by the different consonant insertion rules. Regrettably, the formal procedure for filling these slots is not specified in any detail. The status of such optional consonants is not clear anyway, since Tranel writes:

> ". . . it is important to emphasize that the consonants given in parentheses [. . .] are not part of the phonological representations of the adjectives; rather, they are idiosyncratic phonological markings which are simply part of the lexical entries." (p. 238)

It will be clear that Tranel's analysis has certain advantages compared to the standard analysis. There is no need for extrinsic ordering of Consonant Truncation and Schwa Deletion; exceptions to Consonant Truncation such as *honnête* 'honest' simply have a final non-optional consonant in their lexical representations; and the syllabic position of consonants in liaison context (i.e. tautosyllabic with the following vowel) is also expressed.

Yet Tranel's analysis suffers from a serious drawback: it is not generalizing. For instance, it does not express the fact that all the different rules of consonant insertion that Tranel is forced to assume insert these consonants in exactly the same phonological configurations.

Another problem is that empty C's must also be inserted before each derivational suffix in order to bring the stem-final consonants to the surface, as in *petit/petitesse, soldat* [sɔlda] 'soldier'/*soldatesque* [sɔldatɛsk] 'soldier-like' and *lait* [lɛ] 'milk'/*laitier* [lɛtje] 'milkman', a consequence that is not mentioned by Tranel.

For these reasons we reject Tranel's analysis.

The insight that in liaison the word-final consonant has become tauto-syllabic with the following vowel is the cornerstone of the theory of French C/∅-alternations proposed by Anderson (1982), with the following rules for liaison and consonant truncation respectively:

(11) *Liaison*[3]

$$_\sigma[\text{X} \quad \text{(C)}] \quad \# \quad _\sigma[\text{V} \quad \text{X}]$$

$$\begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array}$$

$$\Longrightarrow \; _\sigma[1] \qquad _\sigma[2 \quad 3 \qquad 4 \quad 5]$$

(12) *Obstruent Truncation*[4]
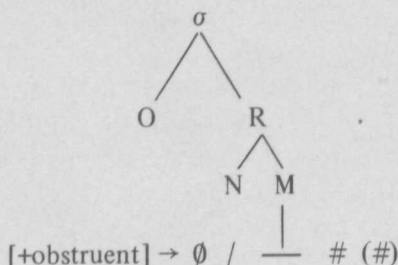
$$[+\text{obstruent}] \rightarrow \emptyset \; / \; \underline{\quad} \; \# \; (\#)$$
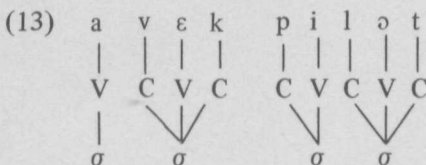
The rule of Liaison performs the required resyllabification: a word-final C becomes tautosyllabic with the initial vowel of the next word. The rule of Obstruent Truncation deletes syllable-final obstruents in word-final position. Since Truncation is ordered after Liaison, the final /t/ of, for instance, *petit* does not delete in the phrase *petit ami*.

This analysis also accounts for the surfacing of stem-final consonants in inflected and derived words. In *petite*, the underlying structure is /pətit+ə/. Due to the additon of the suffix /ə/ and concomitant automatic resyllabification, the stem-final /t/ shifts to a syllable onset, and thus will not be deleted. Moreover, it is no longer word-final.

Anderson's analysis demonstrates once again that it is absolutely necessary to incorporate the notion 'syllable' and, more generally, prosodic structure into phonological theory. This does not mean, however, that Anderson's analysis of the C/∅-alternations is the only feasible one in the framework of prosodic phonology. Clements and Keyser (1983) have proposed a very attractive alternative prosodic analysis of the French facts outlined above which makes use of the notion 'extrasyllabicity'. It is this latter analysis which I think must be preferred, as will be argued in the next section.

3. FRENCH C/∅-ALTERNATIONS AND EXTRASYLLABIC CONSONANTS

Clements and Keyser (1983), henceforth CK, propose, inspired by Mc-Carthy's prosodic theory of non-concatenative morphology (McCarthy 1981) a three-tiered theory of the syllable. The phonological representation of each word is provided with a syllabic structure with three tiers: the segment-tier, the CV-tier, and the σ-tier (σ=syllable). For instance, the words *avec* 'with' and *pilote* 'pilot' will receive the following representations:

(13)
$$
\begin{array}{cccc}
a & v & \varepsilon & k \qquad p \quad i \quad l \quad \mathfrak{o} \quad t \\
| & | & | & | \qquad | \quad | \quad | \quad | \quad | \\
V & C & V & C \qquad C \quad V \quad C \quad V \quad C \\
| & & \vee & \qquad \quad \vee \qquad \vee \\
\sigma & & \sigma & \qquad \quad \sigma \qquad \sigma
\end{array}
$$

CK now introduce the notion of extrasyllabicity: in French word-final consonants can be marked as extrasyllabic. Thus, these consonants will be skipped by the syllabification rules and not linked to the σ-tier. Such consonants will therefore delete, unless they are linked to the σ-tier by some rule. CK suggest that this concept of extrasyllabicity can be employed in the description of the liaison phenomena of French. For instance, *petit ami* and *petit garçon* will receive the following representations:

(14)
$$
\begin{array}{cccccccccccc}
p & \mathfrak{o} & t & i & t & \quad a & m & i \qquad p & \mathfrak{o} & t & i & t \qquad g \quad a \quad r \quad s \quad \tilde{\mathfrak{o}} \\
| & | & | & | & | & \quad | & | & | \qquad | & | & | & | & | \qquad | \quad | \quad | \quad | \\
C & V & C & V & C & \quad V & C & V \qquad C & V & C & V & C \qquad C \quad V \quad C \quad C \quad V \\
\vee & & \vee & & & \quad | & \vee & \qquad \vee & & \vee & & \qquad \vee \qquad \vee \\
\sigma & & \sigma & & & \quad \sigma & & \sigma \qquad \sigma & & \sigma & & \qquad \sigma \qquad \sigma
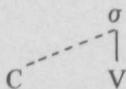\end{array}
$$
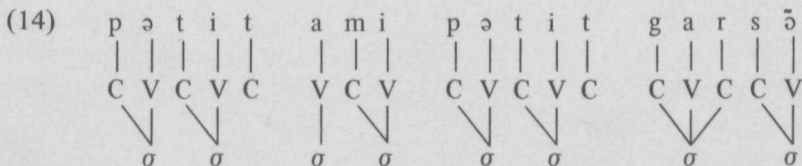
Note that in both phrases the final *t* of *petit* is not linked to the σ-tier. In the case of *petit garçon* this *t* will therefore be deleted by the following rule (CK, p. 105):

(15)   C' → ∅

where C' stands for an extrasyllabic consonant.

Liaison can now be formulated as a rule which links an extrasyllabic C to the σ-tier (CK, p. 104):
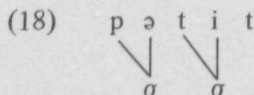
(16)   *Liaison*[5]

$$\sigma$$
$$C \cdots\cdots V$$

The dotted line indicates the linking between the extrasyllabic C and the σ-tier of the following, vowel-initial syllable. Rule (16) must, of course, also be provided with a specification of the liaison domain. It will derive the following representation for *petit ami*:

(17)   p ə t i t   a m i

The structure shows C V C V C   V C V with σ σ σ σ' below.
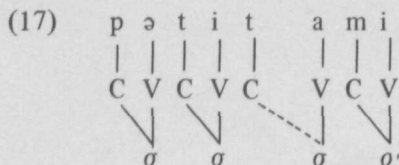
In (17) the final *t* of *petit* is no longer extrasyllabic, and will therefore not be deleted by rule (15), provided that rule (15) is ordered after rule (16).

In the case of *petits amis* /pətit+z ami+z/ both the stem-final /t/ and the plural suffix /z/ are extrasyllabic. Liaison will shift the /z/ but not the /t/. Hence the /t/ remains extrasyllabic and will delete by (15).

The notions 'CV-tier' and 'extrasyllabicity' are theoretically independent. We can also admit extrasyllabic consonants without also assuming the notion 'CV-tier'. For instance, we could as well provide *petit* with the representation.

(18)   p ə t i t

with σ σ below.

and formulate liaison as follows:

(16)'   *Liaison*

$$\sigma$$
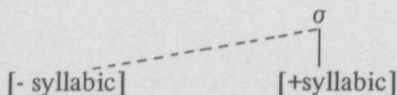
[- syllabic]   [+syllabic]

Note that CK define the notion 'extrasyllabicity' as follows: "a segment P is extrasyllabic iff it is dominated by no node σ". Clearly, the notion CV-tier does not play a role in this definition. Therefore, I will make no further reference to the CV-tier in the rest of this paper, since it is

only the notion 'extrasyllabicity' which is relevant for my analysis. I will also refrain from discussing whether syllables must be assigned a hierarchical structure, since, again, this is irrelevant here.

Restricting ourselves to Consonant Truncation, CK's theory compares favourably with Anderson's theory: it can account very simply for exceptions, and it also accounts for the truncation of consonants which are not obstruents.

As we saw above, there are many words that do not undergo Consonant Truncation. Since in these words the final consonants always surface, they would have to be marked as negative exceptions to Anderson's rule of Consonant Truncation. In CK's theory, on the other hand, these words are simply provided with a lexical representation without extrasyllabic consonants.

A second advantage of CK's analysis is that it can easily be extended to those sonorant consonants that also alternate with zero, in particular the /r/. The /r/ only alternates with zero in words in -ier such as dernier 'last' and premier 'first', and in léger 'light'. Compare:

(19)   premier [prəmje]/première [prəmjɛr] 'first, masc./fem.'
        premier étage [prəmjeretaž] 'first floor'/ premier garçon
        [prəmjegarsõ] 'first boy'

In both Dell (1980) and Anderson (1982) sonorants are not included in the structural description of the rule of Consonant Truncation. Nasal consonants are not mentioned because they have the special property of causing nasalization when they delete, and therefore their behaviour is covered by a special rule of Nasal Truncation. CK also treat nasals separately. They note that nasal consonants also delete word-internally, as in bonté [bõte] 'goodness'. The /r/ is not mentioned by Dell and Anderson because normally it does not delete (cf. rare, bizarre, fort, divers, tard etc.). In the CK-framework the few /r/'s that alternate with zero can simply be marked as extrasyllabic, whereas in e.g. rare the final /r/ does not possess such a diacritic feature.

In section 5 we will encounter some other problematical aspects of Anderson's analysis.

4. THE NATURE OF FRENCH EXTRASYLLABICITY

The question now arises whether the enrichment of phonological theory with the notion 'extrasyllabicity' is motivated for French only, or also for other languages. In this section I will argue that such languages do exist, but that the nature of French extrasyllabicity is different from the other cases of extrasyllabic segments.

In Spanish the selection of the correct allomorph of the diminutive suffix is dependent on the number of syllables of the basis word. However, words such as *escuela* 'school' behave like disyllabic words with respect to the selection of the diminutive allomorph. This can be explained by assigning such words lexical representations without an initial *e*. The initial *e* is a predictable segment, inserted by a rule of epenthesis because Spanish does not permit word-initial clusters of *s* + Consonant. Thus the lexical representation of *escuela* will be /skuela/. However, this implies that at the level of initial syllabification the initial *s* of /skuela/ cannot be associated with the σ-tier, *sk* being an impossible syllable onset in word-initial position. Therefore, the /s/ is extrasyllabic, and only surfaces since the rule of *e*-epenthesis saves this extrasyllabic segment from deletion (cf. Jaeggli 1977, Ingria 1980).

A second example of a language with extrasyllabic consonants, provided by Ingria (1980), is Greek. Greek has the following alternations:

(20) so:ma/so:matos   'body, nom/gen'
      damar/damartos   'wife, nom/gen'
      gala/galaktos   'milk, nom/gen'
   leo:n/leontos   'lion, nom/gen'

The C/∅-alternations in (20) can be accounted for by assuming a word-final /t/ in the underlying form of the stem of these words, and an underlying cluster /kt/ in the case of *gala*. Ingria then points out that ancient Greek tends to avoid word-final and even syllable-final stops. Therefore, the lexical stem-final *t*'s can be considered extrasyllabic. They surface in inflectional morphology, but not in word-final position due to the following convention or filter (cf. Cairns and Feinstein 1982: 219):

(21) *Non-syllabified segment deletion*
     Delete from phonetic representation any segment that is not dominated by σ.

Both Ingria (1980) and Cairns and Feinstein (1982) remark that they do not want to regard (21) as a universal convention but as a language-specific rule, because in certain languages, such as Spanish, the deletion of extrasyllabic segments is avoided by the application of epenthesis rules. However, this is no argument against the universal interpretation of (21), since it can be considered a filter at the end of the phonological derivation, when all other rules, including epenthesis rules, have applied. It will be clear now that CK's rule (15) for French can also be replaced by this convention, which is similar, though not identical to the convention in autosegmental phonology that tones which are not anchored to a tone bearing element are not realized phonetically (McCarthy 1981:382, 399).

A third example is Sinhala (Cairns and Feinstein 1982). In this language the causative suffix *-wa* can be added to a lexical root like *anda* 'to put on'. The causative suffix also induces the deletion of the root-final vowel of polysyllabic roots. Thus we get *andwa*. Cairns and Feinstein claim that there is no possible well-formed syllabification for this word, since *ndw-* and *dw-* are impossible syllable onsets, and *-nd* cannot be a coda in Sinhala. Therefore, the *d* cannot be linked to an σ-node, and will be deleted by (21):

(22) a n d w a
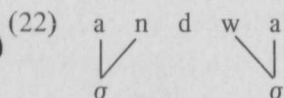
In conclusion, it seems that the introduction of the notion 'extrasyllabicity' is a well motivated extension of prosodic phonology. There is an important difference, however, between extrasyllabicity in Spanish, Greek and Sinhala and extrasyllabicity in French. In the latter case the extrasyllabicity of certain consonants does not follow from the fact that the syllabification principles of French do not admit the linking of these consonants to an σ-node. The many exceptions to Consonant Truncation show that word-final consonants are possible. That is, in French extrasyllabicity is a diacritic feature of certain consonants.

Let us represent this diacritic feature of French word-final consonants as [+ ex].

As was pointed out above, extrasyllabic consonants do not only lose their extrasyllabicity in liaison-contexts, but also in inflectional and derivational morphology. For instance, the final /t/ of *petit* also surfaces in *petite* and *petitesse*. This follows from the Peripherality Condition for extrametrical constituents proposed by Hayes (1982:270)

(23)   X   → [- ex]/ —— Y]$_D$

[+ ex]

where Y $\neq \emptyset$ and D is the domain of the stress rules

if we subsume the notions 'extrametricality' and 'extrasyllabicity' under one notion 'extraprosodicality' and generalize the Peripherality Condition to extraprosodic constituents. Thus in the case of *petitesse* the stem-final /t/ of *petit* will lose its extrasyllabicity because it is no longer word-final and hence will be linked to the σ-node dominating the first vowel of *-esse* by means of the process of automatic resyllabification that applies after each application of a morphological or phonological rule. The case of the masc. plur. form of *petit*, /pətit+z/ will be different. Here, an extrasyllabic plural suffix /z/ is added to the stem. Therefore, we can take the sequence

of an extrasyllabic /t/ plus an extrasyllabic /z/ as the value of X in (23), and thus the /t/ does not lose its extrasyllabicity. Consequently, the phonetic form of e.g. *petits amis* is [p(ə)tizami].

One might wonder why the rule of Liaison itself cannot account for the surfacing of the stem-final /t/ of *petit* in *petitesse* by linking this /t/ to the syllable-node that dominates the first vowel of *-esse*. The first reason is that Liaison is a variable, style-dependent rule, whereas the surfacing of the /t/ in *petitesse* is obligatory. Secondly, we also find pairs of words like *respect* [rɛspɛ] 'respect'/*respecter* [rɛspɛkte] 'to respect' and *aspect* [aspɛ] 'aspect'/*aspectuel* [aspɛktyɛl] 'aspectual', where two extrasyllabic consonants surface in the derived words, whereas Liaison links only one consonant to the σ-tier. That is, the surfacing of both consonants only follows from the Peripherality Condition.

Although this is also pointed out by CK (p. 106) they do not analyse related facts with respect to Liaison. In a phrase like *mon circonspect ami* 'my cautious friend', where the final /kt/-cluster of *circonspect* is extrasyllabic, both the /k/ and the /t/ surface, although it is only the /t/ that is linked to the following word *ami*. Let us therefore reformulate the Peripherality Condition as follows: 'An extraprosodical constituent X loses its extraprosodicality unless it occupies the following position: ·· X $[\begin{smallmatrix} Y \\ + ex \end{smallmatrix}]_D$, where Y may be zero'. Suppose, furthermore, that we represent the cluster /kt/ in *circonspect* as an extrasyllabic constituent:

(24)   s i r k õ s p ɛ k t
                                    $\bigvee$
                                  [+ ex]

Given these assumptions, we predict that the cluster /kt/ of *circonspect* will surface in liaison context, since it does not occupy the position prescribed for extrasyllabic constituents, once Liaison has applied.

We note a difference here with cases like *petits amis*, where the stem-final /t/ of *petits* does not surface, although the /z/ does. This follows from the fact that here the sequence /tz/ does not form a constituent: an extrasyllabic /z/ is added to a stem ending in an extrasyllabic /t/:

(25)   p   ə t i t   z
                  [+ex]   [+ex]

After the application of Liaison, the constituent /t/ still occupies the position required for extrasyllabic constituents, and therefore it remains extrasyllabic and is deleted at the end of the phonological derivation. Thus, we get the phonetic representation [p(ə)tizami].[6]

To conclude, the nature of French extrasyllabicity is different from that of the other languages mentioned above: it is a diacritic feature. Yet there is one universal involved here, the principle that extrasyllabic segments delete at the end of the phonological derivation. This makes rule (15) as a language-specific rule of French superfluous.

5. FURTHER EVIDENCE FOR EXTRASYLLABICITY: THE INTERACTION OF CONSONANT TRUNCATION AND E-ADJUSTMENT

In this section I will adduce further evidence for the claim that CK's theory of liaison is superior to other analyses, in particular that of Anderson (1982). This evidence concerns the interaction of consonant truncation and the so-called rule of E-adjustment.

Standard French exhibits a well known alternation between [e] and [ə] on the one hand, and [ɛ] on the other, as illustrated in (26):

(26) e/ɛ: céder   [sede]   'to yield'   (il)   cède   [sɛd] 'yields'
      ə/ɛ: appeler [apəle] 'to call'   (il)   appelle [apɛl] 'calls'

This alternation also occurs in pairs of masc./fem. adjectives such as *premier* [prəmje]/*première* [prəmjɛr] 'first', *particulier* [partikylje]/ *particulière* [partikyljɛr] 'particular'. Basbøll (1978: 171) proposes to account for this alternation by means of a rule of Closed Syllable Adjustment (also referred to as E-adjustment):

(27)   *Closed Syllable Adjustment*
       e, ə → ɛ / —— ····)$_\sigma$ where σ is a closed syllable

In this analysis, Basbøll presupposes that in forms such as *cèdera* [sɛdəra] 'yield, fut., 3rd sg.' the first syllable is still closed, because it contains a full vowel and therefore attracts at least one consonant to its coda. The same applies to the emphatic pronunciation of *cède* as [sɛdə]. This assumption is necessary in order to get the [ɛ] in the first syllable. However, it is a rather doubtful assumption since the optimal syllabification of e.g. *cèdera* and *cède* clearly are (sɛ)$_\sigma$ (də)$_\sigma$ (ra)$_\sigma$ and (sɛ)$_\sigma$ (də)$_\sigma$ respectively. This problem has been solved by Selkirk, who proposes a reformulation of the rule so that it applies in the domain of the foot(Σ) (Selkirk 1980: 578):[7]
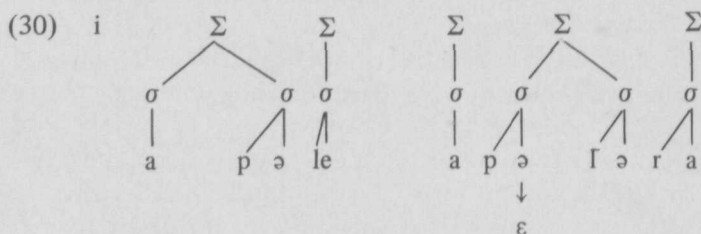
(28)   *E-adjustment*

       e, ə → ɛ / (X —— Y)$_\Sigma$ Condition: Y ≠ ∅

This reformulation presupposes that in French all syllables are indepen-
dent feet except for sequences of two syllables of which the second con-
tains a schwa. That is, the following types of foot are assumed:

(29) Σ Σ

     σ σ_s σ_w

                  ə
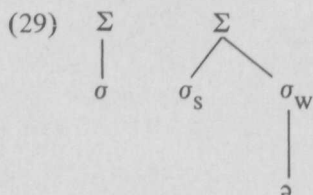
The prosodic structures of *appeler* and *appelera* will now look like:

(30) i Σ Σ Σ Σ Σ

     σ σ σ σ σ σ σ

     a   p ə le   a p ə   l ə r a

                           ↓

                           ε

The rule of E-adjustment only applies to the first schwa in (30ii) since in
(30i) the schwa is not followed by other phonological material in the same
foot, i.e. $Y = \emptyset$.

The type of alternation exemplified by E-adjustment also occurs
in Bordeaux French, but in this dialect it is on a much larger scale. Here
we find the following pairs of alternating vowels: e/ɛ, ö/œ, o/ɔ: the low
variants of the mid vowels occur in the context —— $Y)_\Sigma$, with $Y \neq \emptyset$,
and the high variants in the same context, but with $Y = \emptyset$, i.e. foot-
finally. The following examples from Rochet (1982:79) illustrate this:

(31) i   je cède [sɛdə]/nous cédons [sedõ] 'I/we yield'
        je cueille [kœjə]/nous cueillons [köjõ] 'I/we pick'
        je donne [dɔnə]/nous donnons [donõ] 'I/we give'

     ii   mauvais [move]/mauvaise [movɛzə] 'bad, masc./fem.'
        heureux [örö] /heureuse [örœzə] 'happy. masc./fem.'
        sot [so] /sotte [sɔtə] 'stupid. masc./fem.'

     iii   aveugle [avœglə] 'blind'/aveugler [avögle] 'to make blind'

Let us now consider the interaction of E-adjustment and Consonant
Truncation. A major advantage of the introduction of extrasyllabic con-

sonants is that it eliminates the necessity of extrinsic ordering of E-adjustment after Consonant Truncation. Such an ordering is necessary if we assume that word-final consonants that alternate with zero do not bear a diacritic feature [+ex]. This would imply that we get the following prosodic structure for the masc. sg. adjective *premier*:

(32)
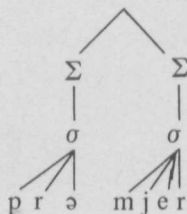
Consonant Truncation has to delete the final consonant *r* here before E-adjustment is applied, because otherwise the incorrect phonetic form *[prəmjɛ] could be derived. The theory of extrasyllabic consonants on the other hand provides the following prosodic structure:
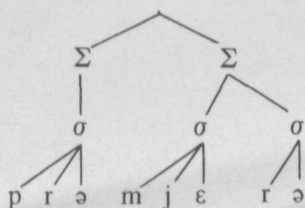
(33)
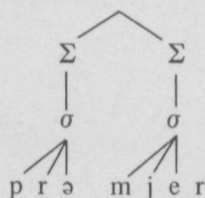
In this representation the final *r* does not form part of the second foot. Thus the rule of E-adjustment is blocked, because the condition 'Y ≠ ∅' is not met. In the feminine adjective *première* E-adjustment does apply, as is shown by the following derivation:

(34)
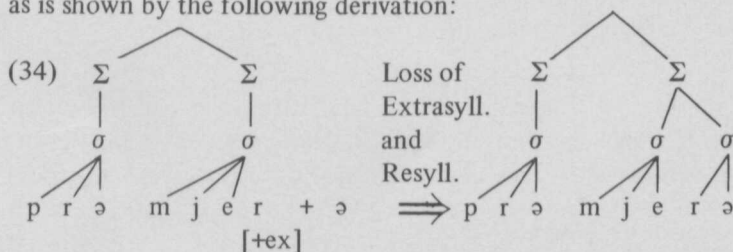
After schwa-deletion we arrive at the phonetic form [prəmjɛr].

It is worth while to compare this analysis with Anderson's. A crucial assumption of Anderson's is that French schwa's are underlyingly empty nucleus nodes. Such an empty nucleus node is deleted if its σ-node does not dominate other segments. Otherwise, a schwa will be inserted in the empty position. The empty syllables are deleted by the following rule (Anderson 1982: 553):

(35) $[_{\sigma} \emptyset] \rightarrow \emptyset$

Furthermore, Anderson assumes that there is a rule of word-internal resyllabification of the following form:

(36) $[_{\sigma} C_0 \ V \ C_0 \ ] \ [_{\sigma} C_0 \ \emptyset \ ] \ \#$
       $\quad$ 1 $\quad$ 2 3 $\qquad$ 4 $\quad$ 5 $\quad$ 6
$\Longrightarrow \ [_{\sigma} 1 \ \ 2 \ 3 + 4] \quad [_{\sigma} \ \ 5 \ ] \ 6$

Both rules apply to, for example, *achète* /ašθt+∅/ 'buys' (cf. *acheter* /ašθt+e/ 'to buy'). First, rule (36) transfers the *t* of *achète* to the preceding syllable. Consequently, the final syllable has become completely empty, and thus deletes by (35). In between these two rules the rule of Closed Syllable Adjustment changes ∅ into [ɛ] in closed syllables. Consequently, the derived phonetic form [ašɛt] is obtained.

Anderson now assumes the following extrinsic ordering of rules:

1. Resyllabification (rule 36)
2. Closed Syllable Adjustment
3. Obstruent Truncation (rule 12)
4. Empty Syllable Deletion (rule 35)

The extrinsic ordering Closed Syllable Adjustment – Obstruent Truncation is based on the argument that since words such as *cachet* [kašɛ] 'seal, stamp' and *cacheter* [kašte] 'to seal up' are related, the underlying form of *cachet* has to be /kašət/ (or, to be more precise, /kašθt/). With respect to such words Closed Syllable Adjustment has to precede Obstruent Truncation, because otherwise the final syllable of *cachet* would be open, thus blocking the necessary application of Closed Syllable Adjustment. Secondly, Empty Syllable Deletion is ordered after Obstruent Truncation, in order to save, for example, the final *t* of the feminine adjective *petite* [pətit] from Truncation.

However, this ordering runs into problems when we take alternations such as *premier/première* into account. If, as Anderson assumes, the un-

derlying final *r* is linked to the σ-tier, Truncation must precede Closed Syllable Adjustment, because otherwise the masculine form of the adjective will be assigned the phonetic form [prəmjɛ], which is incorrect. Admittedly, Anderson does not have to face this problem, because his Truncation rule applies only to obstruents. But this implies that a separate rule of *r*-Truncation must be added to the grammar, ordered before Closed Syllable Adjustment. Moreover, in Bordeaux French we also find pairs of words with the relevant vowel alternation that end in obstruents, for instance *sot/sotte* (cf. 31). It is clear that here Obstruent Truncation would have to precede the vowel adjustment rule because otherwise we would get the wrong phonetic form [sɔ] for *sot*.

Another problematical aspect of Anderson's analysis is that it makes the alternation e,ə/ɛ dependent on the deletion of a schwa: the rule of Resyllabification which feeds the rule of Closed Syllable Adjustment also feeds the rule of Empty Syllable Deletion. Note, however, that the schwa also has to change into an [ɛ] in, for instance, the second syllable of *appellera* /apələra/, where there is no concomitant loss of the schwa in the third syllable. Again, Bordeaux French also nicely illustrates this point, because in this dialect even word-final schwa's are always realized phonetically and yet the alternation between [+mid, +high] and [+mid, -high] vowels is systematically present (cf. Rochet 1982).

Our conclusion is that Anderson's analysis suffers from the following drawbacks: it does not generalize across obstruent truncation and /r/-truncation, it makes E-adjustment dependent on schwa-deletion, which is empirically incorrect, and it requires a number of ordering statements, which is at least a descriptive complication.

On the other hand, in the CK-framework we only have to assume a rule of E-adjustment. This rule cannot apply to vowels in syllables ending in extrasyllabic consonants, and consequently no ordering with respect to consonant truncation is required.

The only question that remains to be answered in our analysis is, how to relate *cachet* and *cacheter*. In the CK-framework, *cachet* will receive the following prosodic structure:

(37)   k   a   š   ə   t
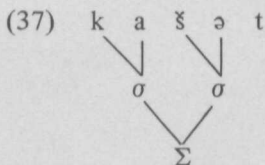
if we assume an underlying schwa and also add foot structure. But E-adjustment does not apply to this structure since the schwa is in foot-final position. Therefore, we have to assume the underlying form /kašɛ(t)/
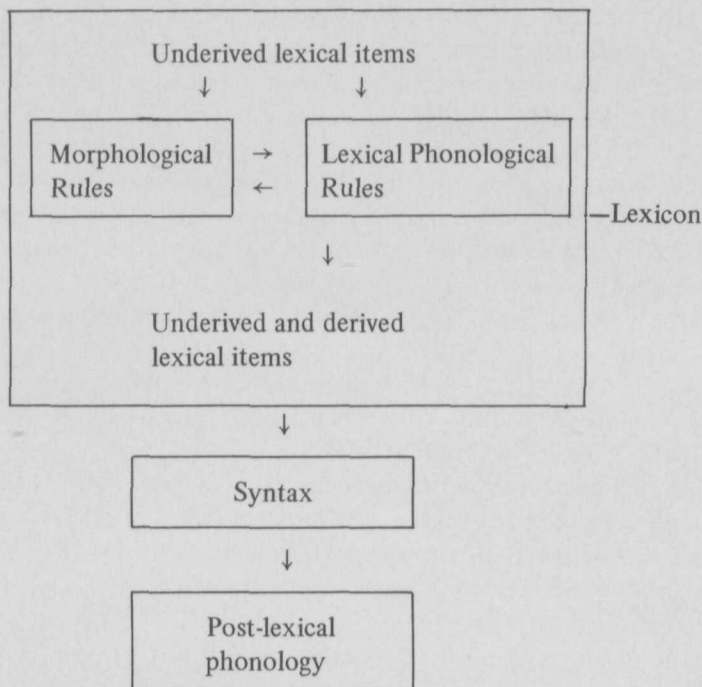
instead, and derive *cacheter* [kaš(ə)te] by means of some rule of vowel reduction that changes /ɛ/ to /ə/. Note that the underlying form /kašət/. is implausible anyway: before the verb *cacheter* was derived, the underlying form of *cachet* must have been /kašɛt/ since there was no alternation. So the underlying form of *cacheter* must have been /kašɛt+e(r)/, which implies the existence of a rule that converts the /ɛ/ into a schwa.

6. LEXICAL PHONOLOGY: CYCLIC AND POSTCYCLIC RULES

Although the previous section showed that the CK-analysis of French C/∅-alternations makes correct predictions with respect to the interaction of consonant loss and E-adjustment, things seem to be more complicated when we take a more detailed look at these C/∅-alternations and their relation to liaison, enchaînement and the interaction of these latter rules with E-adjustment. It is the aim of this section to show that the model of Lexical Phonology proposed by Kiparsky (1982) is able to predict the ways in which these rules interact, provided that we add an important distinction to this model: that between cyclic and postcyclic rules.

The theory of Lexical Phonology assumes a distinction between two types of phonological rule: lexical and postlexical rules. Lexical rules apply in the lexicon, postlexical rules after syntax. A lexical phonological rule can apply directly after a morphological rule, as soon as its conditions are met. Thus, abstracting from the subtheory of level ordering that is not relevant for the present discussion, Kiparsky assumes the following organizational model:

(38)

Underived lexical items
↓   ↓

| Morphological Rules | → ← | Lexical Phonological Rules |

↓

Underived and derived
lexical items

—Lexicon

↓

Syntax

↓

Post-lexical
phonology

This model can be seen as a formalization of the traditional distinction between word phonology and sentence phonology. We may assume that all phonological rules that exclusively apply within words are located in the lexicon (perhaps apart from low level and style-dependent rules), whereas all other phonological rules are located in the post-lexical component, as was suggested by Booij (1981). Such a division is not simply a notational variant of the extrinsic ordering of phonological rules, since it makes the prediction that all word level rules precede all the rules that (also) apply in domains larger than the word.

This model makes correct predictions with respect to the interaction of liaison, enchaînement and E-adjustment. French has two processes of external sandhi that obliterate the boundaries between words by shifting the final consonant to a following vowel-initial word: liaison and enchaînement. The difference is that liaison applies to latent consonants, whereas enchaînement applies to consonants that surface anyway.

The difference between these two processes of external sandhi manifests itself indirectly, for instance in the phonetic differences between *premier ami* and *première amie*:

(39) i   premier ami $(\text{prə})_\sigma(\text{mje})_\sigma(\text{ra})_\sigma(\text{mi})_\sigma$ 'first friend, masc.[8]
      ii première ami $(\text{prə})_\sigma(\text{mjɛ})_\sigma(\text{ra})_\sigma(\text{mi})_\sigma$ 'first friend, fem.'

The syllabification patterns of the two phrases are completely identical. The difference between the [e] in *premier* and the [ɛ] in *première* follows from the theory of extrasyllabicity combined with the theory of Lexical Phonology: the /e/ of *premier* is not affected by the lexical rule of E-adjustment, since its final syllable is open. On the other hand, the /e/ of *première* is changed into [ɛ] since the latent consonant /r/ of its stem has lost its extrasyllabicity in the lexicon due to the addition of the female schwa-suffix, and consequently the /e/ is no longer foot-final. A similar minimal pair is *un sot enfant* $[(so)_\sigma(t\tilde{a})_\sigma(f\tilde{a})_\sigma]$ 'a stupid child' versus *une sotte aventure* $[(sɔ)_\sigma(ta)_\sigma(v\tilde{a})_\sigma(ty)_\sigma(rə)_\sigma]$ 'a stupid adventure' (Rochet 1982: 85).

These facts also stress the importance of the word as a structural unit of French phonology, although the word boundaries are obliterated at the surface level (cf. Rochet 1977).

A parallel phenomenon can be found in Canadian French, which laxes high vowels in closed syllables (cf. Rochet 1977: 194-95, Tranel 1981: 268). This rule must also be considered a lexical rule and thus indirectly shows the difference between liaison and enchaînement:

(40)   i   petit ami $(pə)_\sigma(ti)_\sigma(ta)_\sigma(mi)_\sigma$
       ii petite amie $(pə)_\sigma(tI)_\sigma(ta)_\sigma(mi)_\sigma$

Again, this opposition follows from our analysis.

So far, Kiparsky's model (38) makes correct predictions. However, there are certain complications with respect to the French C/∅-alternations that induce us to propose a refinement of this model, namely the distinction between a block of cyclic and a block of postcyclic rules.

It is well known that adjectival and nominal stems behave differently with respect to latent consonants. Nominal stems (= roots plus derivational endings), although they show C/∅-alternations in inflectional and derivational morphology, do not exhibit these alternations in liaison contexts. Compare:

(41)   un marchand italien   'an Italian merchant'
       un avocat éminent   'an outstanding lawyer'

The stem-final consonants of *marchand* and *avocat* are never realized in liaison contexts, whereas the plural morpheme /z/ for nouns can surface in such contexts. Therefore, we have to assume the following rule:

(42)   *Extrasyllabic Consonant Truncation*
       C' → ∅ / ——]$_{\text{Nominal Stem}}$

A standard example to demonstrate this difference between adjectival and nominal stems is the phonetic difference between the following two phrases:

(43)   un [savant]$_A$ [anglais]$_N$ 'a learned Englishman'
       un [savant]$_N$ [anglais]$_A$ 'a English scholar'

The final /t/ of *savant* is only pronounced in the first phrase.

The principle of loss of stem-final extrasyllabic consonants holds for verbal stems as well: they never surface with these consonants in liaison-context. Compare:

(44)   je regarde [regard]/regarder [regarde] 'I look upon/to look upon'
       je sors [sɔr]/ sortir [sɔrtir]   'I go out/to go out'
       je perds [pɛr]/perdre [pɛrdrə]   'I lose/to lose'

In the case of verbs with an infinitive in -*er* the 1st pers. sg. pres. form gets a morphological schwa. Hence the stem-final consonant in *je regarde* loses its extrasyllabicity and surfaces. On the other hand, the 1st pers. sg. pres. forms of verbs in -*re* like *perdre* have a zero-ending. Thus the stem-final /d/ of *je perds* remains extrasyllabic and will have to be deleted before Liaison applies, since it does not surface in liaison contexts. Therefore, rule (42) must be extended to verbal stems:
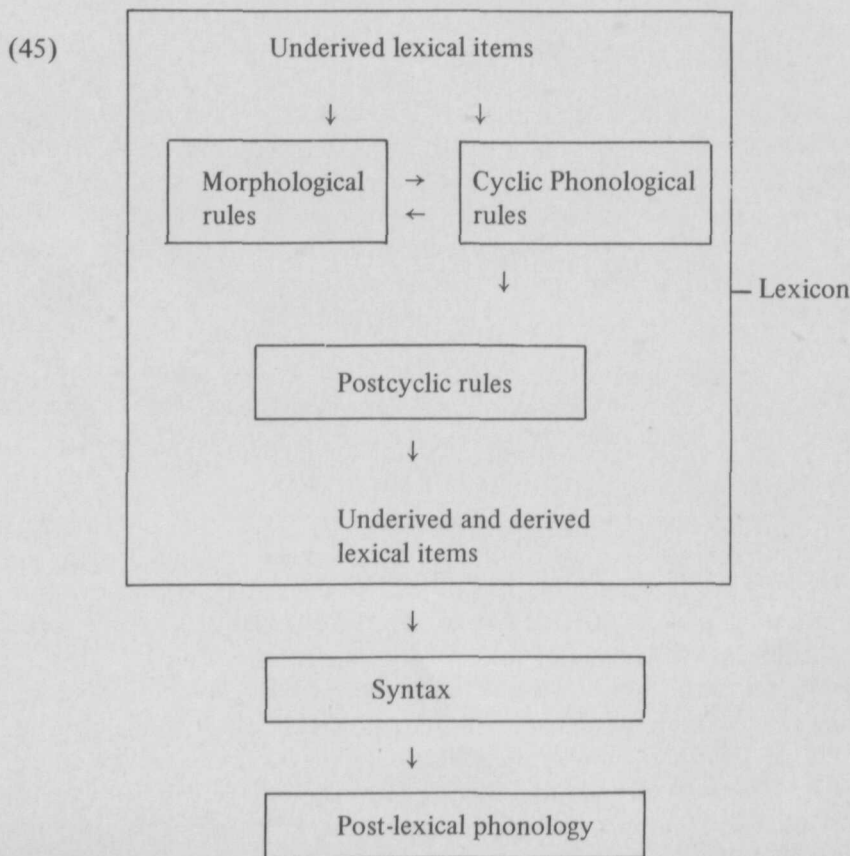
(42)'   *Extrasyllabic Consonant Truncation* (revised)[9]
         C' → ∅ / ——]$_{\text{Nominal Stem, Verbal Stem}}$

Let us now consider the question of where exactly this rule has to apply. Since the rule applies only word-internally, it is a lexical rule. This is confirmed by the fact that it must apply before the rule of Liaison, a rule of sentence phonology, because otherwise Liaison could make these extrasyllabic consonants surface. In Kiparsky's model, this would imply that (42)' is a cyclic rule, since the model claims that all lexical rules are cyclic: they apply in tandem with morphological rules, and (re)apply as soon as a domain of application has been created. Yet, rule (42)' cannot be cyclic, because these stem-final consonants may only be deleted after the block of morphological rules; compare *marchand* [maršã] with *marchandise* [maršãdíz] 'merchandise', or *avocat* [avoka] with *avocate* [avokat] 'female lawyer'. Therefore, this rule has to be a postcyclic rule in the lexicon. This position is predictable: the context of rule (42)' implies that it is a lexical rule, and its postcyclicity follows from the fact that it concerns extrasyllabic segments: a cyclic rule that deletes extrasyllabic

segments would turn the notion 'extrasyllabicity' into a senseless one, because extrasyllabic segments would never get the chance to surface.

Now we have two points where extrasyllabic consonants are erased: at the end of the lexical component and at the end of sentence phonology. A similar proposal is made by Steriade (1982) who proposes a 'stray' segment erasure convention at the end of both lexical and postlexical phonology. However, the facts of French unambiguously show that stray segments at the end of the lexical component cannot be erased by a universal convention, but by a language-specific rule only, either context-free or context-sensitive (as in the case of French).

The revised model of Lexical Phonology as argued for above will have the following form:

(45)

```
┌─────────────────────────────────────────────────┐
│            Underived lexical items                │
│                 ↓            ↓                     │
│        ┌──────────────┐   ┌──────────────────┐    │
│        │Morphological │ → │Cyclic Phonological│   │
│        │rules         │ ← │rules              │    │
│        └──────────────┘   └──────────────────┘    │
│                      ↓                         ─ Lexicon
│            ┌──────────────────┐                   │
│            │ Postcyclic rules │                   │
│            └──────────────────┘                   │
│                      ↓                            │
│            Underived and derived                  │
│            lexical items                          │
└─────────────────────────────────────────────────┘
                       ↓
            ┌──────────────────┐
            │      Syntax       │
            └──────────────────┘
                       ↓
            ┌──────────────────────┐
            │ Post-lexical phonology│
            └──────────────────────┘
```

This model has also been proposed by Booij (1981). Rubach (1981) also shows that one has to distinguish between cyclic and postcyclic rules, and that cyclic rules are ordered in one block before the block of postcyclic rules.

There is another phenomenon that can be very nicely accounted for in the framework developed so far: the difference in pronunciation between *grand ami* 'great friend, masc.' and *grande amie* 'great friend, fem.' (cf. Sten 1962: 60, Carton 1974: 218):

(46)   grand ami $(\text{grã})_\sigma(\text{ta})_\sigma(\text{mi})_\sigma$

      grande amie $(\text{grã})_\sigma(\text{da})_\sigma(\text{mi})_\sigma$

There is no difference in syllabic structure between the two phrases; the only difference is that the final /d/ of the masculine adjective is realized as [t]. This devoicing process also applies to /g/ as in *un long espoir* [œ̃ lɔ̃kɛspwar] 'a long hope'. This difference in pronunciation between the latent consonant of the masculine form and the consonant of the feminine form that is always realized can be accounted for by a lexical postcyclic rule that devoices extrasyllabic plosives:

(47)   C'
$$\begin{bmatrix} - \text{ son} \\ - \text{ cont} \end{bmatrix} \rightarrow [-\text{voice}]$$

The rule cannot be cyclic because the /d/ is realized as [d] in the feminine adjectives. On the other hand it must be ordered before Liaison, since after Liaison all phonological differences between *grand ami* and *grande amie* will be erased. Therefore, it has to be a lexical postcyclic rule. Moreover, the postcyclicity of the rule also follows from the fact that it is context-free: context-free rules can only be postcyclic (cf. Rubach 1981).

7. CONCLUSIONS

The introduction of the notion 'extrasyllabic consonant' as proposed by Clements and Keyser (1983) appears to be a well motivated enrichment of phonological theory. It enables us to account for the French C/∅-alternations in a way that is clearly superior to both the standard account, as presented in Dell (1980) and the recent syllable-oriented analysis in Anderson (1982).

CK's main argument for the introduction of extrasyllabicity in the analysis of French latent consonants is that it allows the relation between the effect of Liaison on prosodic structure and the surfacing of latent consonants to be expressed. Moreover, in this analysis minor cases of consonant truncation such as /r/-truncation in words in *-ier* can be covered without additional rules.

In this paper, I have adduced additional arguments for CK's analy-

sis: that the loss of extrasyllabic consonants at the end of the phonological derivation follows from a universal convention, and that the assumption of extrasyllabic consonants correctly predicts how C/∅-alternations affect E-adjustment.

Finally, I have shown that the theory of Lexical Phonology, although it makes correct predictions with respect to the order of application of certain phonological rules of French, must be revised, in that a distinction has to be made between a block of cyclic rules and a block of postcyclic rules within the lexicon.

Generally, this paper demonstrates that the prosodic structuring of phonological strings is of crucial relevance for a proper account of French C/∅-alternations, but also that an enriched conception of the organizational structure of grammars leads to a substantial simplification of the phonological grammar of French.

NOTES

1. It should be realized that liaison is not only dependent on structural phonological factors, but also on stylistic ones. For instance, the liaison in the final example of (4) is rather unusual. Lexical factors also play a role. See also Morin and Kaye (1982) for a critical analysis of Selkirk's theory of domains, as outlined in Selkirk (1972, 1974).

2. The rule of word-final schwa-deletion seems to apply almost obligatorily. If it applied *completely obligatorily, it would be a case of absolute neutralization.* However, Dell (1980: 161) states that in his idiolect of French, the feminine word-final schwa surfaces before the '*h*-aspiré', as in *grosse housse* [grosəus] 'big dust-sheet'

3. This formulation of the rule of liaison suffers from a serious drawback: it mixes prosodic and grammatical properties by also mentioning the word boundary # in the structural description. Thus Anderson's rule results in a syllable with a # between the onset and the rhyme. This mixture of grammatical and prosodic structure should be avoided (cf. Pike 1979, Halle and Clements 1982:15, Booij 1982).

4. O = Onset, N = Nucleus, R = Rhyme, M = Margin. The optional # in the structural description of this rule is not relevant here. Cf. Anderson (1982:561-62) for an explanation.

5. In a previous version of this analysis in Clements and Keyser (1981) the rule of Liaison is formulated as a rule that only links extrasyllabic consonants to a following vowel-initial syllable. The new rule accounts for both liaison, the surfacing of latent consonants, and enchaînement, the resyllabification of consonants that always surface. However, it is not certain whether the two phenomena can be accounted for by one rule; see Booij (to appear).

6. The example *mon circonspect ami* has been taken from Selkirk (1972:228), who points out that this phrase is a problem for the analysis of liaison in Dell (1970). In this latter thesis, Dell makes an attempt to express the relation between liaison and enchaînement in the framework of standard generative phonology by assuming the following rule of Liaison Metathesis:

$$[-\text{ syll}] \quad \# \quad [+\text{ syll}]$$
$$1 \quad\quad 2 \quad\quad 3 \implies 2 \ 1 \ 3$$

The problem for this analysis noted by Selkirk is that the /k/ of *circonspect* will still be deleted by word-final consonant truncation, which is incorrect. Selkirk also argues that this problem cannot be solved by metathesizing *two* word-final obstruents, because in *petits amis* only the /z/ surfaces although both /t/ and the /z/ are latent. However, this problem can be solved by making use of the feature [+ex], as shown in the text.

Note that the objection that Selkirk raises against Dell's analysis, also holds for Anderson (1982).

7. Noske (1982:300) claims that words such as *derechef* 'once more', *démesure* 'excess', *développer* 'to develop' and *revenir* 'to return' are counterexamples to Selkirk's reformulation of E-adjustment, since in these words the vowel of the first syllable does not change into an [ɛ]. However, Noske does not take the prefix status of the first syllables into account. Prefixes may be considered to be independent feet or phonological words (cf. Basbøll 1978:155, who assumes that each French prefix is followed by a word boundary #). If these prefixes do not form a foot with the following syllable, they are no longer counterexamples.

The same applies to Noske's observation that in, for example, *je ne crois pas* 'I do not think so' the schwa of *je* is not changed into an [ɛ]. This change would only be expected if *je* and *ne* form one foot, which is very doubtful because they are separate words.

Basbøll (1981: 40) mentions some real problematical cases such as *Genevois* [Žənəvwa] 'inhabitant of Geneva', which are real exceptions or counterexamples unless one assumes an /œ/ instead of an [ə] as the underlying vowel of the first syllable. One could also conclude that E-adjustment has become lexicalized.

Note, furthermore, that my remarks on Anderson's analysis remain relevant, even if the rule of E-adjustment in standard French would have to be considered a rule of Closed *Syllable* Adjustment.

8. Fouché (1959²:435) also mentions the pronunciation [prəmjɛrami] for *premier ami*, but Rochet (1977:193, fn. 19) remarks that according to Durand this pronunciation is extremely rare.

9. Exceptions to this rule are nouns in lexicalized phrases like *accent aigu*. See Grammont (1938) for more examples.

CK do not give a consistent description of the facts here since they claim that "noun and verb stems never terminate in extrasyllabic consonants" (p. 103), but also remark that "stem-final consonants regularly truncate while inflectional endings may undergo liaison" (p. 104). On p. 106 they also assume that nominal stems like *aspect* and *respect* have word-final extrasyllabic consonants.

The necessity of a postcyclic rule that refers to labeled brackets that may be word-internal, as in e.g. [[avokat]$_{\text{Nom.Stem}}$z]$_N$ is also a problem for Kiparsky's Bracketing Erasure Convention, which erases internal brackets at the end of each level, cf. Kiparsky (1982).

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