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THE ANALYSIS OF FRENCH SHWA: OR, HOW TO GET SOMETHING FOR NOTHING

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A number of classical problems in the phonology of French are considered, especially as they relate to the vowel 'shwa' (*e-muet*). From the rule of Closed Syllable Adjustment (which relates shwa and [ɛ]), it is concluded that French phonology must be described in terms of representations making explicit provision for syllabic, as well as segmental, structure. The formal representation of syllable structure is discussed, and a concrete proposal is made. On this basis, it is suggested that the vowel shwa should be regarded as a phonological syllabic nucleus unfilled by any phonetic content in underlying structure—analogous to 'empty nodes' in syntax. It is shown that this representation provides a natural treatment of the facts of vowel alternation and elision that have been problematic for previous accounts of shwa. A particular advantage of this analysis is the resulting description of '*h*-aspiré' words: these can be characterized as vowel-initial words that are exceptions to a single general schema of 'enchaînement'. Implications for other areas of French phonology, including the treatment of nasal vowels, are also suggested.*

The phonology of French, perhaps more than any other single language, has served as the testing ground for a wide range of theories. Major statements from a variety of traditional and structuralist points of view have been based on the facts of French, by writers as diverse as Delattre 1966, Félice 1950, Fouché 1956, Grammont 1914, Hall 1948, Hjelmslev 1948, Malmberg 1975, Martinet 1945, 1956, Togeby 1951, Trager 1944, 1955, and a host of others. Within the generative tradition, Schane 1968 provided one of the most influential early descriptions of an entire linguistic system, and thereby established much of the climate of abstractness in descriptions that characterized the work of this period. Increasing disillusionment with extremely abstract, quasi-etymological analyses was reflected (still within the same general line of theoretical development) in the descriptions of Dell 1973 and Selkirk 1972. Investigators such as Cornulier 1975, 1977, Morin 1974, 1978, and Walker 1973 have de-

* Two initial caveats are in order. First, this study is confined to 'standard' French, represented by such conservative sources as Fouché 1956 and Grevisse 1959. While the description of this norm may (or may not) generalize easily to other dialects, this is not considered relevant to the present description. Similarly, many speakers who consider their language to be 'standard French' may well deviate from this norm in more or less significant ways. Such idiolectal variation is, again, treated as not directly relevant to the description of the particular form of speech discussed here. Second, I have made no attempt to be comprehensive in my citation of either examples or references. The facts under discussion have, by and large, been rehearsed often enough to make this unnecessary, though I review them in the initial sections below. A comprehensive survey of both facts and references will be found in Tranel 1981.

I should like to express my appreciation to the participants in my 'French phonology' proseminar at UCLA in the Spring of 1980, who have contributed significantly to my understanding of the facts to be discussed below. These included J. Bailard, G. Bedell, M. Godinez, J. Gonzalez, M. Hammond, R. Janda, C. Otero, D. Platt, T. Thomas-Flinders, and L. Tuller. Useful comments have also been received from a number of others on the occasions when I have presented preliminary versions of this paper orally: comments provided by F. Dell, J. Emonds, M. Halle, W. Leben, and B. Tranel, concerning an earlier written version, have been particularly helpful. Most of these people are not to be blamed for my mistakes.

veloped the analysis of a coherent range of issues in French phonology to a considerable depth, and in some cases have anticipated results to be discussed below. More recently, French has served as the factual basis for major statements in terms of 'Natural Generative Phonology' (cf. Klausenburger 1978, Tranel 1981). There is thus no single language on the basis of which one can better assess a view of phonological structure in relation to other perspectives.

Such a relatively uniform factual base for the comparison of theoretical views is of considerable value. If one compares, e.g., the insights provided by a Natural Generative Phonology of an Ethiopic language with those to be found in a glossematic view of Danish (the sort of situation in which one often finds oneself), it is hard to know how to discover which approach better captures the nature of sound patterns in natural language in general. But the variety of available accounts of French (and in particular, of the essentially conservative standard language defined approximately by such classic traditional treatments as Fouché, Grammont, and Grevisse) ensures a sufficiently broad theoretical context for such questions to become meaningful.

Much of the recent theoretical work done within the 'standard' paradigm of generative phonology (cf. Anderson 1978) has been devoted to elaborating the notion of phonological representations. In particular, a variety of proposals have been made for enriching the homogeneous, linear, segment-based model of classical generative (and much other) phonology by the recognition of units larger—and perhaps also smaller—than the traditional phonetic segment. Work such as that of Liberman 1975, Liberman & Prince 1977, Goldsmith 1976, Anderson 1976, Halle & Vergnaud 1978, and McCarthy 1979b has established the linguistic significance of domains of phonological structure and specification both above and below that of the segment. In particular, work like that of Kahn 1976 and McCarthy 1979a—as well as earlier discussions such as those of Hooper 1972, Vennemann 1972, and a number of the papers in Bell & Hooper 1978—has brought the notion of syllabic structure back into a central position in current theorizing.

It is the purpose of this paper to contribute to the evaluation of such work by providing a treatment of some basic rules of French phonology within a framework that explicitly recognizes syllable structure, along with segmental structure, as available for the statement of rules and for manipulation by rule. By facilitating explicit comparison with available descriptions in other terms, this treatment should put the particular virtues of a syllable-based analytic framework into better perspective.

A number of analytic problems in French, although of central importance to the description of the language, are somewhat orthogonal to my concerns here; so I will make a number of assumptions in these regards without much explicit discussion. In particular, I assume roughly the description of underlying forms argued for by Dell 1973, 1980, in which many words end underlyingly in final consonants that are subject to truncation by rule (rather than ending in vowels, with consonants INSERTED by rule); and many forms (especially feminine forms of adjectives, and some designated verb forms, as well as certain stems of nouns, verbs, and other categories) end in a vowel 'shwa'

which protects their final consonants from truncation, though it is itself subject to loss in a variety of environments; and many instances of nasal vowels are derived from underlying sequences of oral vowel plus nasal consonant. All these assumptions have been challenged in the recent literature (most comprehensively by Tranel 1981), and I do not at all mean to imply that they are uncontroversial; however, it seems that the objections that can be raised against this position can all be substantially answered, and that this framework brings a considerably greater degree of coherence and understanding to the facts than any alternative that has been proposed.

Much of the controversy in the generative literature on French (beside that alluded to in the previous paragraph) has centered on the analysis of the vowel system and of vocalic alternations in the language. Schane based his work on a rather 'abstract' notion of the underlying vowel system, in which vowels are distinguished as 'tense' vs. 'lax', and in which a number of vowel quality alternations which appear in derivational morphology, and in the paradigms of traditionally irregular verbs, are described by regular phonological principles. It is probably fair to say that this approach has been generally abandoned in recent years (partly as a result of discussions such as those of Walker 1975, Tranel 1977, Dell & Selkirk 1978, and Dell 1979), and that a rather more 'concrete' view of the French vowel system again prevails. On this view, the underlying forms of most vowels are rather similar to their surface phonetic values, and the majority of the quality alternations treated by Schane as purely phonological are described by morphologically conditioned processes like the rule of 'Learned Backing' discussed by Dell & Selkirk. Accordingly, I assume that the basic oral vowel system of French includes the elements in Figure 1.

High	/i/	/y/		/u/
(Higher mid)	/e/ (= é)	/ø/		/o/
(Lower mid)	/ɛ/ (= è)	/œ/		/ɔ/
Low	/a/		/ɑ/	
	[- round]	[+ round]	[- round]	[+ round]
		[- back]		[+ back]

FIGURE 1.

I do not discuss here the problem posed for the feature system of Chomsky & Halle 1968 and Anderson 1974 by the apparent existence of four vowel heights and of two distinct low unrounded vowels; it seems, on the basis of the data in Fouché, that a good case can be made for treating both the opposition between higher mid and lower mid vowels and that between the two low unrounded vowels as basically one of length (rather than quality), but I will not pursue the point. The elements in Fig. 1 will be referred to below simply by the corresponding unanalysed symbols.

In addition to the oral vowels, standard French also has nasal vowels. As mentioned above, and elaborated in §7 below, many instances of these are to be derived from underlying sequences of oral vowel plus nasal consonant; but there is no reason to doubt that, in at least some non-alternating forms, underlying nasal vowels are present. The conservative dialect described by the

sources which I take as defining the domain of the present investigation (e.g. Fouché, Grevisse) has four nasal vowels, all of which are low. These are shown in Figure 2.

[ẽ]	[œ̃]	[ã]	[ɔ̃]
[- round]	[+ round]	[- round]	[+ round]
	[- back]		[+ back]

FIGURE 2.

In addition to the above vowels, however, another vocalic element generally appears in descriptions of French. Both phonological and phonetic representations within a variety of traditions have posited an element 'shwa', usually represented as /ə/. The next several sections will deal with the properties and analysis of this vowel.

1. SOME PROPERTIES OF SHWA. Descriptions of French typically assume the existence of an additional vowel 'shwa' in expressions like *le garçon* [ləgɑrsɔ̃] 'the boy', *petit* [pəti] 'little' (masc.), and *livre noir* [livrənwar] 'black book'. The symbol /ə/ thus appears in both phonological and phonetic forms, and seems to represent a vowel distinct from any of those described above. However, when the phonetic identity of this vowel is investigated, it appears (at least for most speakers of the 'standard' dialect under consideration), that it is not distinct from the vowel /œ/. A certain amount of variation exists in the actual details of the realization of this vowel (particularly with respect to the degree of rounding found in various environments); but the essential point is that this variation is shared by /ə/ and /œ/, which do not differ from each other (with one exception, to be noted below) in their surface value.¹

Since /ə/ is phonetically the same as /œ/, the use of two distinct representations clearly is intended to reflect a phonological rather than a phonetic opposition. In fact, the vowels generally transcribed as /ə/ differ in their phonological behavior in several respects from those transcribed as /œ/. One of these is their respective relations to the location of word stress (for a description and motivation of which, cf. Dell 1981). While the vowel /œ/ frequently occurs in stressed syllables (in words like *neuf* [nœf] 'nine'), the vowel /ə/ never occurs under stress, except in monosyllables—e.g. in exclamatory *que* (*QUE c'est joli!* 'Isn't it beautiful!'), in postposed object clitic *le* in the imperative (*Prends-LE!* 'Take it!'), or with emphatic stress (*LE grand chef* 'THE big chief'). Basically, word stress in French falls on the final syllable (cf. Walker 1975, Dell 1981); but if that syllable contains /ə/, then stress falls on the penultimate syllable. Thus a final shwa cannot receive stress in polysyllabic words; and a shwa in penultimate position is replaced by a different quality when the last syllable of the word also contains a shwa, as we will see below. The rules of the language thus generally prevent stress from falling on a 'phonetic' [ə], though they allow stress to fall on [œ] quite freely. We cannot, however, attribute the difference between /ə/ and /œ/ solely to stress, since the two are distinguished

¹ For the phonetic identity of 'shwa' and [œ], cf. Dell 1973, Tranel 1981, and references cited there.

in unstressed pretonic syllables (e.g. *genêt* [žəne] 'furze' (a shrub) vs. *jeunet* [žœne] 'youngster').

The principal basis for distinguishing /ə/ from /œ/ in French is not their differing relations to stress, but rather the fact that some instances of phonetic [œ] (those represented as /ə/) alternate with zero, while others are stable. The word *pelouse* 'lawn', e.g., shows a vowel [œ] between its first two consonants in some environments (*cette pelouse* [setpœluz] 'this lawn'), but not in others (*la pelouse* [lapluz] 'the lawn'). By contrast, a word like *seulette* 'lonely' (fem.) shows a vowel [œ] in all environments: *la seulette* [lasœlet] 'the lonely one' (fem.), *cette seulette* [setsœlet] 'this lonely one' (fem.). I thus represent the first syllable of *pelouse* with a /ə/, and that of *seulette* with a /œ/, to reflect the difference between 'unstable' and 'stable' [œ].

If the difference between /ə/ and /œ/ is limited to the difference between 'stable' and 'unstable' instances of the same vowel, then the use of two distinct symbols is purely diacritic; and most phonologists would probably agree that such positing of absolute neutralization (cf. Kiparsky 1973a) is illicit in the absence of further arguments. Nonetheless, while the problem of how to represent 'unstable' [œ] or shwa has been raised in various works, the issue remains. The two vowels must clearly be distinguished if the rules of the phonology are to operate correctly; but no phonetically-based feature can be motivated to separate them. Most authors have simply continued to write /ə/ in some forms and /œ/ in others, leaving the problem of the underlying value of /ə/ unsolved.

One possible resolution of this difficulty, of course, would be to assume that /ə/ is not present in underlying representations at all, but is rather inserted in some positions by a rule of epenthesis. In that case, the rule in question could simply insert [œ], and the difference between /œ/ and shwa in underlying forms would be represented as the difference between the presence of a vowel and its absence. However, as Dell 1973 makes clear, this analysis cannot possibly be made to work. Words like *pelouse* show that, in some environments, the proposed epenthesis rule would insert [œ] between word-initial /p/ and a following /l/ (giving *cette pelouse* [setpœluz]); however, in other words (e.g. *place* 'square'), epenthesis must be prevented in the same environment (*cette place* 'this square' is always [setplas], never *[setpœlas]). A wide range of forms show similar behavior; so it is clear that, if we tried to treat all instances of shwa as epenthetic, it would be necessary to mark most clusters in most words for whether or not they were subject to epenthesis. Since this would be equivalent to positing an additional phonological vowel element, it would constitute no advance on our original account. We are once again left with the problem of how to distinguish phonologically between two phonetically identical vowels.

One further difference between the behavior of /ə/ and that of /œ/ should be noted, at least for the sake of completeness. In absolute final position, /œ/ raises to become a higher mid vowel [ø] in words like (*je*) *veux* [vø] '(I) want' (cf. *ils veulent* [ivœl] 'they want'). But when shwa occurs in final position, it does not raise: *Prends-le!* is phonetically [prələ], not [prələ], for most speakers. This might well be attributed to the structural description of the raising

process—which raises /œ/ (as well as /ɔ/, which becomes /o/ by the same rule), but not /ə/, before #—and thus supports the phonological distinction between the two vowels. For those speakers who allow [prələ] for *prends-le*, we must assume that the raising rule is limited to stressed final /œ/, and thus applies both to /ə/ and to /œ/. Only in the case of speakers who do not allow [prələ] (and these seem to be in the majority) does the final raising rule provide clear evidence for the distinction at issue here. But it appears that, even for speakers who allow raising of final shwa in *prends-le*, raising is impossible in forms like *sur ce* 'on this' or *parce que* 'because'; hence it is likely that, for speakers who allow raising, postposed *le* here behaves exceptionally (cf. preposed *me*, *te* vs. independent *moi*, *toi*).²

Nonetheless, the facts of stress placement and the vowel/zero alternations (which will be described in more detail below) are quite sufficient to motivate the assumption that the phonological representations of French words must include, in addition to the vowels in Figs. 1–2 above, an additional element corresponding to the traditional shwa. This conclusion is common to nearly all analyses of the language: controversy about shwa has centered not on its existence, but rather on its role in the morphology. As mentioned above, I assume here, without explicit justification, something like the 'standard generative' account of French morphology (represented by works such as Dell 1973). On that view, the vowel shwa has a distribution which is nearly the same as that of the other vowels in the language. In particular, the vowel appears internal to stems (e.g. *secouer* 'shake'; cf. *Jacques secoue* [žaksœku] 'Jacques shakes' vs. *Marie secoue* [marisku] 'Marie shakes'). It also appears in final position in some stems (e.g. *triste* 'sad'; cf. *un triste roman* [ætɾistœromā] 'a sad novel'), and as the phonological formative marking certain grammatical categories (especially the feminine of adjectives, e.g. *petite* [pœtit] /pœtit + ə/ 'little' [fem.] vs. *petit* [pœti] /pœtit/ 'little' [masc.]; but also some verbal categories). Shwa also occurs as the only vowel of a small but significant class of monosyllables (mostly pronouns and other clitics, such as *je*, *me*, *le*, *ne*, *ce* etc.) Shwa thus has essentially the same distribution as do other vowels of French, with one interesting exception: it cannot occur initially. This fact will turn out to be important for the analysis developed below.

2. SOME RULES AFFECTING SHWA. Having sketched in §1 some of the evidence for assuming that a phonological element corresponding to the traditional shwa exists, I now proceed to summarize the rules which govern its appearance. The primary characteristic associated with shwa thus far (aside from its phonetic value of [œ]) is the fact that it alternates with zero in certain environments. As seen above, it is not possible to account for this alternation by means of a rule of epenthesis; accordingly, the rules which will interest us here are formulated as rules that delete the specific element shwa in particular environments. I follow almost entirely the account of these rules given by Dell 1973, 1980.

One of the most general principles governing the appearance of shwa is the

² I am indebted to B. Tranel for these observations.

fact that the vowel generally does not appear phonetically when it would otherwise be word-final. That is, a word like *petite*, whose underlying form (/pətit + ə/) contains a shwa in final position, usually loses this to become phonetic [pətit]. The presence of a shwa in this form follows from its effect in preserving an otherwise final consonant from deletion; it also appears phonetically under restricted circumstances to be mentioned below. In order to account for its general deletion, however, we assume the operation of a rule roughly like this:

$$(1) /ə/ \rightarrow \emptyset / V C_0 ___ \#$$

The condition that the shwa to be deleted must be preceded by another vowel is imposed to ensure that deletion does not apply when the shwa in question is the only vowel of a monosyllable (e.g. *je parle* 'I speak'). This condition also applies to the vowel of a clitic pronoun when it is inverted with its verb (e.g. *Fais-le!* 'Do it!'), since I assume that it continues to be separated from the verb by the boundary element #, which prevents rule 1 from applying.

There is considerably more to be said about the operation of rule 1 ('Final Deletion'): in particular, the presence of certain clusters in the surrounding environment may result in the preservation (or perhaps re-insertion) of a final shwa. These factors have been studied in Dell 1976, 1977, 1978; they must be provided for in a complete account of the rule, but are apparently irrelevant to my main concerns here. The approximation to the rule of Final Deletion given here as rule 1 will suffice for our purposes.

However, one circumstance in which rule 1 does not apply is directly relevant to the analysis presented here, and we must take note of it. When the following word (within certain syntactic structures—roughly, within phrases of the sort within which final consonants are elided or liaison can take place) is one of a class traditionally called '*h*-aspiré' words, deletion does not take place. The words in question begin phonetically with a vowel (though the orthography often shows an initial *h* in these as well as some non-*h*-aspiré words); however, as classically described, these words act as if they begin with a consonant. Their major peculiarity is that final consonants truncate before them (which does not usually happen with vowel-initial words); and final vowels do NOT truncate. These properties of *h*-aspiré words will be dealt with again in §6 below; but note that, in addition to their anomalous behavior with respect to elision and truncation, *h*-aspiré words have the property of blocking the operation of rules deleting shwa. Thus the word *houss* 'dust-cover' is a member of the *h*-aspiré class (as shown by the fact that its article has the full form, in *la houss* 'the dust-cover', rather than the elided form **l'houss*); and when a preceding word ends in shwa, that shwa is thereby protected from deletion. For instance, in *quelle houss* [kelœus] 'which dust-cover', the shwa at the end of *quelle* is preserved; but it is not in *quelle outre* [kelutr] 'which water skin', since *outre* 'water skin' is not a member of the *h*-aspiré class. I do not incorporate the behavior of *h*-aspiré words into rule 1 at this point; however, my account must eventually provide a way to block the operation of the rule in this case.

Another circumstance under which shwa is deleted is when it is preceded within a word by a vowel from which it is separated by exactly one consonant:

$$(2) /ə/ \rightarrow \emptyset / V C ___$$

The operation of this rule, which we will call '(Internal) VCE', can be seen in the paradigm of verbs such as *acheter* 'buy'. The second vowel of this stem is a shwa, which appears as [ɛ] in, e.g., 3sg. *achète* [aʃɛt] 'buys'; where it is not converted to another vowel, the shwa is deleted by rule 2, since it is separated from the preceding /a/ only by the single consonant [ʃ]. Further instances of the operation of this rule will be seen below.

In an environment which is essentially the same as that of rule 2, shwa is also deleted in external sandhi:

$$(3) /ə/ \rightarrow \emptyset / V \# C ___$$

Under these conditions, however, the rule—'(External) VCE'—is not obligatory, but optional. Thus *je repars* 'I leave again' can be pronounced either as [ʒærepɑr], if rule 3 is not applied, or as [ʒærpɑr] if it is. However, a form like *Jacques repars* 'Jacques leaves again' can only be pronounced [ʒakrepɑr]; the shwa is here separated from the preceding vowel by two consonants, and rule 3 is thus inapplicable.

Rules 2–3 can interact with each other, since the shwas deleted by either rule are of course vowels, and each can serve as part of the environment for the application of the other. Thus a form like *tu devenais* 'you (sg.) became' contains two successive syllables with shwas (/tʷ#dəvənɛ/). The first of these is potentially subject to deletion by rule 3, while the second is subject to deletion by rule 2. In fact, there are two possible pronunciations of this form: either as [tʷdəvɛnɛ], where rule 2 but not rule 3 has applied; or as [tʷdvɛnɛ], where rule 3 but not rule 2 has applied. But it is not possible to pronounce this form as *[tʷdvɛnɛ] by applying both rules.

In such forms, then, either of the two VCE rules can apply so long as both do not. This result can be obtained easily enough by simply ordering the rules: if External VCE precedes Internal VCE, it will bleed the latter when it applies, thus preventing both rules from affecting contiguous syllables in the same form. Thus the operation of External VCE on /tʷ#dəvənɛ/ will produce /tʷ#dvɛnɛ/; if Internal VCE does not get to apply until this point, its environment will no longer be satisfied. If External VCE has not applied, however, the form will still be as it was, and Internal VCE applies to produce /tʷ#dəvɛnɛ/ as required. The fact that Internal VCE is obligatory where its environment is satisfied accounts for the fact that one of the two rules must apply (i.e., *[tʷdəvɛnɛ] is not possible, except as an over-careful pronunciation). So long as External VCE is not allowed to apply again AFTER the internal rule, there is no way to derive the incorrect *[tʷdvɛnɛ].

While the device of ordering is sufficient to describe the way in which rules 2–3 interact, other examples show that more remains to be said. In particular, when we consider examples in which two or more successive syllables contain shwas subject to the same deletion rule, the ordering solution is of no assistance. Thus, in a phrase like *tu le retrouves* 'you find it again', both the shwa of the

second syllable (*le*) and that of the third (*retrouves*) are subject to deletion by rule 3. From the underlying form /tū#lə#rətr.../ three pronunciations are possible: [tūlə#rətruv], where neither shwa is deleted; [tūlə#rətruv], where the first is; and [tūlə#rətruv], where the second is deleted. Rule 3 describes all these possibilities, of course, since its application is optional. (I assume this optionality is 'local'; i.e., it is optional with respect to each particular vowel which it might potentially affect, independent of its effect on other vowels in the same form.) However, the pronunciation *[tūlə#rətruv], where rule 3 has been applied to both shwas in the underlying form, is not a possible pronunciation, and this fact remains to be explained.

Ordering of rules alone is obviously of no use in this case, since only a single rule is relevant. The generalization appears to be that External VCE can apply optionally to any syllable, so long as it does not affect two ADJACENT syllables in a single form. This becomes even clearer when we consider longer sequences of syllables with shwas. A phrase like *envie de te le demander* 'desire to ask you it' has a sequence of four consecutive syllables, all of which are potentially subject to rule 3. In fact, any one or two of these (or none) can be deleted, so long as ADJACENT shwas are not affected. There are thus eight distinct possible outputs, shown schematically in Figure 3.

	/ ...	ā	v	i	#	ə	#	t	ə	#	l	ə	#	d	ə	m	ā	d	e	... /
a.						ø		œ			ø			œ						
b.						ø		œ			œ			ø						
c.						œ		ø			œ			ø						
d.						ø		œ			œ			œ						
e.						œ		ø			œ			œ						
f.						œ		œ			ø			œ						
g.						œ		œ			œ			ø						
h.						œ		œ			œ			œ						

FIGURE 3.

Of course, not all eight possible pronunciations are equally likely. Nonetheless, all are PHONOLOGICALLY possible, as opposed to the inadmissibility of any pronunciation with two consecutive shwas deleted. While much of Fouché's discussion of shwa deletion amounts to an enumeration of all possible combinations of deletable shwas, the generalization which governs all the possibilities is the same: adjacent syllables cannot undergo shwa deletion.

In addition to the attempts in traditional linguistics to account for these facts in terms of a 'law of three consonants' (which can easily be shown to be inadequate), a considerable literature has developed within generative phonology in the effort to capture the above generalization about shwa deletion. The problem arises, of course, because (at least on the view of rule application suggested by Chomsky & Halle) the operation of the rule in one syllable might be supposed to be independent of its operation in another. Since the rule can potentially affect ANY of the shwas in Fig. 3, some additional device is necessary to prevent it from affecting certain combinations but not others.

One possible approach is that based on the notion of 'directional' application of phonological rules (cf. Johnson 1970, Howard 1972). According to this view,

rules apply to a form in only one place at a time, scanning it in a particular direction (either from left to right or from right to left, depending on the rule). Assuming that rule 3 applies in this fashion from left to right, the correct results will be obtained. Starting at the left, we first have the option of deleting the shwa of *de*. If we do so, then we move on to the next possible deletion site (the shwa of *te*); but now the conditions for deletion are no longer met, since the previous deletion has destroyed them. If, however, we had chosen not to delete the shwa of *de*, we would still be able to delete the vowel of *te*; etc. As long as the rule is never allowed to return to a segment of the form which it has already considered, this mode of operation will guarantee that two consecutive shwas can never be deleted, since the deletion of any one will bleed the potential deletion of the one immediately following.

An alternative view was sketched by Anderson 1974, according to which the rule applies not directionally, but simultaneously—subject to a general constraint that no element serving crucially as environment for one application of a rule can itself undergo a change produced by the same rule. Without going into the (somewhat baroque) details of the metatheoretic principle by which this effect is produced, it will suffice to say that this view also makes it possible to provide an account of the non-deletion of adjacent shwas; and still other variations on such views have been proposed (cf. Dell 1980, Kenstowicz & Kisseberth 1977).

While there are various ways in which the facts of Fig. 3 can be accommodated within phonological theory, it cannot be said that any of them is overwhelmingly supported by independent evidence; in fact, each of the known possibilities has equally well-known drawbacks (cf. Kenstowicz & Kisseberth). Further, any view of the operation of rule 3 by itself will fail to account for the fact that shwas subject to deletion by rule 2 actually fall under the same generalization: whether rule 2 or 3 is responsible, the fact remains that shwas in two adjacent syllables cannot both be deleted. It would be desirable to have some formulation of the principles involved that had this general condition as a consequence, without needing to invoke additional external devices. It will be suggested below, in fact, that a proper view of the facts of shwa deletion does not necessitate any further mechanisms, such as directional rule application. Before developing that view, however, other facts must be surveyed.

One additional note concerning Internal VCE and External VCE is necessary. We saw above that the deletion of shwas by the Final Deletion rule is blocked when the shwa in question is followed by a word of the *h*-aspiré class. In fact, the same is true of the deletion of shwas by rules 2–3. In a phrase like *pas de hache* 'no axe', we would expect that the shwa of *de* could be deleted by rule 3, parallel to the deletion in *pas de fiche* [padfiʃ] 'no slip of paper'. But the word *hache* 'axe' is a member of the *h*-aspiré class, so this is impossible: the form is pronounced [padœaʃ], not *[padaʃ]. Deletion of shwa in prefixes added to stems of the *h*-aspiré class is also blocked: thus *Va dehors!* 'Go outside!' can be pronounced [vadœɔʁ], but not *[vadɔʁ]. Again, the constraint on the deletion of shwas before *h*-aspiré words seems to be independent of the particular rule performing the deletion.

This concludes my summary of the facts of shwa deletion. I stress again that it is meant to be schematic, rather than complete: the additional considerations raised by various authors must certainly be incorporated into a final account, but I suggest that the theoretical issues addressed below are independent of these further refinements. Let us pass on to one further important aspect of the behavior of shwa.

3. THE SHWA/[ɛ] ALTERNATION. One other property of shwa which distinguishes it from /œ/ is the fact that it alternates with the lower-mid front unrounded vowel [ɛ]. Thus the verb *harceler* 'harass' contains a shwa in its second syllable: [arsœle]. Under certain circumstances, this shwa is replaced by [ɛ]: (*il*) *harcèle* [arsɛl] '(he) harasses', *harcèlement* [arsɛlmā] 'harassment' etc. Similarly, the shwa which is underlyingly present in the second syllable of *achever* 'conclude', but which is deleted by rule 2 (yielding [aʃve]), becomes [ɛ] in forms like (*il*) *achève* [aʃɛv] '(he) concludes', *achèvement* [aʃɛvmā] 'conclusion' etc. An initial approximation to the process at work here can be formulated as follows:

$$(4) /ə/ \rightarrow [ɛ] / ____ C \left\{ \begin{array}{l} \# \\ C \end{array} \right\}$$

I.e., shwa is replaced by [ɛ] when followed by a consonant that is either word-final or part of a cluster. These facts are somewhat simplified from the fuller account given in Dell 1973, 1980 and elsewhere, but will suffice as a basis for discussion.

Note that only shwa, and not /œ/ as well, undergoes rule 4. Given a verb like *abreuver* 'give water (to an animal)', which has an underlying /œ/ in its second syllable, we find that related forms like (*il*) *abreuve* '(he) gives water', *abreuvement* 'watering' etc. have only pronunciations with [œ], such as [abrœv], [abrœvmā]—not pronunciations like *[abrɛv], *[abrɛvmā] as well. It is thus necessary to restrict rule 4 to shwa, and not to allow it to apply to all vowels that could surface as [œ].

Of course, given an alternation of shwa with [ɛ] as in *harceler* vs. *harcèle*, it does not follow that the rule required should convert shwa to [ɛ], rather than the other way around. Indeed, Selkirk 1972 proposed an analysis of this alternation in which [ɛ] is basic for such forms, and becomes shwa under conditions that are the inverse of those specified in rule 4. However, as Dell 1980 observes, such an analysis cannot be maintained, since forms for which underlying /ɛ/ must clearly be posited do not replace it with shwa. One can in fact find minimal pairs of forms with underlying /ɛ/ (which remains constant) vs. underlying shwa (which replace this with [ɛ] by virtue of a rule like 4). E.g., the verb *haleter* 'pant, gasp for breath' has a shwa in its second syllable. In the infinitive, this is lost (by virtue of rule 2, Internal VCE), yielding [alte]; but in forms like 3sg. (*il*) *halète* [alɛt] '(he) pants' or *halètement* [alɛtmā] 'panting', the shwa is replaced by [ɛ] through (approximately) rule 4. Contrast this with the verb *allaiter* [alɛt] 'to suckle, give milk to': its 3sg. subjunctive form is *allaite* [alɛt], homophonous with *halète*; similarly, *allaitement* [alɛtmā] 'suckling, lactation' is homophonous with *halètement*. From the infinitives, how-

ever, we can tell that *allaiter* contains a vowel /ɛ/ in its second syllable, as opposed to the shwa of *haleter*.

A rule similar to 4, then, can be motivated to convert shwa to [ɛ] before certain consonants; and most generative treatments of French phonology have included such a rule. Clearly, however, this alternation is not isolated: in fact, the vowel /ɛ/ (é) also alternates with [ɛ], under the same conditions. Thus the verb *céder* [sede] 'yield' has the vowel /ɛ/ in its initial syllable; when this comes to be followed by a final consonant (as in 3sg. *cède* [sed] 'yields'), /ɛ/ is replaced by [ɛ]. Similarly, the verb *insérer* [ɛsere] 'insert' contains the vowel /ɛ/ in its second syllable, and replaces this by [ɛ] before clusters in words like *insertion* [ɛsɛrsjɔ] 'insertion'. So we might wish to replace 4 by a more general rule:

$$(5) \left\{ \begin{array}{l} /ɛ/ \\ /ə/ \end{array} \right\} \rightarrow [ɛ] / ____ C \left\{ \begin{array}{l} \# \\ C \end{array} \right\}$$

But this would not be all the story, by any means. For one thing, many forms contain instances of the vowels /ə/ or /ɛ/ followed by consonant clusters, where these are not replaced by [ɛ]. Thus the verb *devoir* [dœvwar] 'owe' contains a shwa in its initial syllable (cf. the possibility of deleting the vowel to give *nous devons* [nudvɔ] 'we owe'); but in the future form *vous devrez* [vudœvre] 'you (pl.) will owe', this vowel does not become [ɛ], as evidenced by the impossibility of the pronunciation *[devre]. Similarly, in words like *célébrer* [selebre] 'celebrate', the /ɛ/ of the second syllable is followed by a cluster, without requiring the /ɛ/ to be replaced by [ɛ].

The usual account of these facts (cf. Dell 1973) is to impose a further restriction on rule 5 or its equivalent, to the effect that a consonant cluster which conditions the operation of the rule must not be one of a certain class—in particular, that it not consist exactly of a sequence of obstruent followed by liquid. But this is not an adequate statement of the facts: e.g., from *célébrer* we can form a 3sg. present form *célèbre* [selebr] '(he) celebrates', in which we see the operation of rule 5 before a cluster of obstruent plus liquid. Similarly, from *sevrer* [sœvre] 'wean', with shwa in the first syllable unchanged before the cluster /vr/, the derived 3sg. present form is *sèvre* [sevr] 'weans', in which rule 5 apparently does apply.

The peculiarities of obstruent plus liquid clusters, together with the different behavior of these clusters in medial vs. final position, can both be related to the same fact. In French, these are among the consonant clusters that can begin a syllable (as inferred from the class of word-initial clusters); and so I take it that the difference between obstruent plus liquid clusters and others rests on the fact that the former are syllabified entirely with a following vowel (thus leaving the preceding syllable open), while the latter necessarily belong to different syllables, with the result that a preceding syllable is closed. Of course, a final cluster (as in *sèvre*) cannot be syllabified otherwise than with the preceding vowel, and thus closes its syllable in any case.

It appears, then, that the correct statement of rule 5 would not refer to strings of consonants, boundaries etc. at all, but would rather express the fact that the change of /ə/ and /ɛ/ to [ɛ] happens in CLOSED SYLLABLES. This is involved

in Selkirk's 1972 description of the rule as 'Closed Syllable Adjustment', and the point is argued at greater length by Basbøll 1978. In order to state such a rule, however, it is necessary for phonological rules to have access to a notion of syllabic structure. In the following section, I sketch such a view of phonological representations.

4. THE STRUCTURAL REPRESENTATION OF SYLLABLES. The 'classical' model of generative phonology (as presented in, e.g., Chomsky & Halle, Schane) recognized only one sort of structural unit in phonological and phonetic representations: the segment. There was thus no explicit provision for syllables (or other units, such as prosodic feet and the like) as significant elements contributing to the organization of speech. This was not, as some have suggested, simple oversight or failure of imagination, but rather a matter of principle: while traditional phonetic descriptions of course frequently refer to syllabic structure, and many informal statements of processes in Chomsky & Halle do so as well, the convenience of this unit for ordinary language description does not ipso facto establish its linguistic significance. If it were to turn out that all the statements we might want to make in terms of syllables were, when expressed formally, representable simply in terms of (strings of) segments, WITHOUT IMPORTANT LOSS OF GENERALITY, this would suggest that the more parsimonious and restrictive theory which only allowed reference to such units was in fact essentially correct, and thus to be preferred. It was the attempt to establish this program that lay behind the exclusion of syllable structure from the formalism of early generative phonology.

The issue of the structural importance of syllables has often been confused with a quite independent one: that of the existence of secure phonetic correlates of syllabicity and syllable division. Traditional phonetic literature on the syllables has been (perhaps justifiably) preoccupied with the search for such an articulatory or acoustic basis; but it is important to stress that their linguistic significance does not at all depend on successful results in this area. Indeed, if we ask for a justification of the notion of phonetic segments, we see quickly that the facts of acoustics and of articulatory co-articulation make it quite impossible to segment and identify the speech stream directly in terms of such units. Their justification comes not from our ability to find them clearly in the physical facts of speech, but rather (like any other theoretical entity) from the degree of coherence and order they bring to our understanding of those facts. We describe speech in terms of an ideal string of segments and the complex and highly-structured ways in which the observed facts relate to this representation. Similarly, the justification for including syllable structure in our representation cannot possibly be expected to come directly from the observable facts of speech, but rather must derive from the augmentation in our understanding of those facts that results from the assumption of its presence.

The non-significance of syllables in phonological structure was questioned early, in papers such as those of Hooper and Vennemann. Anderson 1974 attempted to justify the assumption that syllabic structure was potentially significant at every level, from underlying representations through phonetic surface forms. However, such work generally recognized syllabic structure in a

fashion analogous to grammatical structure. Representations were considered to be composed fundamentally of segments as the only structural unit: additional quasi-segmental elements (boundaries, including those of syllables as well as of formatives and words) were considered to be simply intercalated in the segmental string. Such a representation allows for the incorporation of some aspects of syllable-dependent phonology, but leads to other problems. Thus, if the notion of 'ambisyllabic' consonants (belonging simultaneously to two distinct syllables) is valid, it has no plausible representation in terms of syllable boundaries that simply form part of the linear, homogeneous segment string. Further, properties such as stress (and, in some languages, tone) that are properly associated in a unitary fashion with syllables, rather than with their constituent segments, cannot be properly treated if there is no real structural unit corresponding to a syllable.

Among the first to depart from the 'syllable boundary' representation of syllabic structure was Kahn, who assumed that segments were grouped together and associated with syllabic units of another sort. On this view, of course, a single consonant can be associated with more than one such unit; and a phonetic property can, when appropriate, be associated with such a unit rather than with the segments that are (also) linked to it. The developing theory of Autosegmental Phonology also contributed to a richer range of possibilities for the formal treatment of phonological structures, going beyond the linear segmental model; and work like that of Liberman & Prince 1977 and McCarthy 1979a, to name only two influential sources, has by now established the importance of structural units larger than (though related to) the elements of a string of segments.

A number of different views of syllabic structure have been articulated in recent years, and the empirical issues dividing them are not yet clear. Accordingly, I simply sketch here one such view, which will be assumed below with minimal direct justification. I assume that the syllable is a structural element whose theoretical status is on a par with the segment. A representation can thus be 'parsed' both into syllables and into segments. Just as the segment has an internal constituent structure in terms of features,³ the syllable also has internal structure. Its primary division is into a (consonantal) ONSET and a 'RHYME'; the latter is further divided into a (vocalic) NUCLEUS and a (consonantal) MARGIN (often called a 'CODA', but designated here as margin for notational reasons). Each of these constituents, in turn, is associated with a sequence of structural segmental units, as shown in Figure 4 (overleaf).

³ The 'internal constituent structure' of segments is treated to some extent in Anderson 1976. Especially in light of the results of Autosegmental Phonology, it is clear that segments may be composed of consecutive smaller domains; but it may also be the case that segments are usefully regarded as made up of functional constituents, each consisting of the features relevant to some potentially independent articulatory domain. For example, one might regard the features specifying the configuration of the larynx ([spread], [constricted], [stiff], [slack] on one view) as forming a unit; those specifying the configuration of the tongue body ([high], [low], [back]) as another—with still others for the tongue blade, tongue root, lips, and velum. Such an internal structure might define the limits of potentially independent 'autosegmental' specifications.

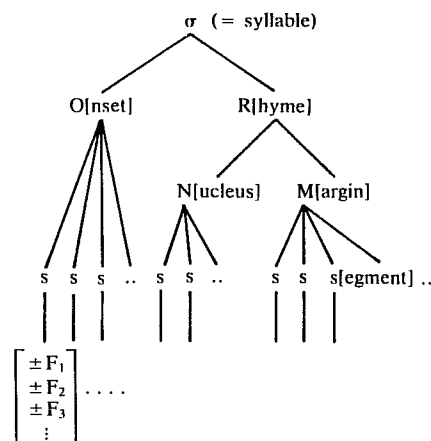


FIGURE 4.

Some aspects of this structure are fairly apparent. The division of syllables into an onset and a rhyme is supported by the widespread independence of these two aspects of the syllable in their relation to prosodic properties such as stress rules, tone assignment, poetic constraints etc. Within the rhyme, the important distinction between open and closed syllables corresponds to the absence vs. the presence of a non-null margin. Further, we can see that this constituent structure represents a way of encoding the feature $[\pm \text{syllabic}]$, which is no longer necessary: $[- \text{syllabic}]$ segments can be treated definitionally as those associated with either the onset or the margin, while $[+ \text{syllabic}]$ segments are exactly those that make up the nucleus of a syllable. Thus the difference between vowels and semivowels now corresponds, not to a difference in features, but rather to a difference in the structural role (attachment to either nucleus or non-nucleus) of the same complex of articulatory features. Similarly, true diphthongs (vowels which change in quality) can be distinguished from sequences of vowel and semivowel, in that the former consist of two distinct nuclear elements, while the latter (though perhaps identical in all other features) are made up of one nuclear and one non-nuclear element. The feature $[\pm \text{syllabic}]$ has always had a peculiar role, and a peculiar status with respect to its distribution in strings of segments: these peculiarities seem to be rationalized by the decision to regard it not as a segmental feature like $[\pm \text{nasal}]$, $[\pm \text{coronal}]$ etc., but rather as a way of referring to the position which a segment occupies within a larger structurally significant unit. In the representations below, I will identify the segments associated with the nucleus as *V* and those associated with non-nuclear constituents as *C* (rather than simply as *s[egment]*); strictly speaking, this should be regarded as a non-significant abbreviation, since the status of any particular segment is unambiguously derived from its structural position within the syllable.

On this view, syllables have a sort of constituent structure that is reminiscent of that assigned to phrases in syntax. Without attempting to pursue this analogy to extremes, it is worthwhile to develop it a bit further. I assume, for example, that languages have principles of syllable structure that are parallel to phrase-structure rules in syntax: thus some languages do not allow margins (i.e., they have only open syllables). Some languages have complex nuclei, with two or perhaps even more possible segment positions in the nucleus (thus allowing for structural long vowels and diphthongs as well as simple vowels), while others allow only simple nuclei (i.e. only simple short vowels phonologically). All languages have some restrictions on the complexity of clusters that can be associated with onsets (and also, if these are present, with margins). Such language-particular principles are quite analogous to syntactic ones.

Despite the existence of such language-particular 'phrasal' principles of syllable structure, however, the amount of variation is narrowly constrained. The analog of the 'X Theory' of phrase-structure rules is the constraint that the syllable-structure principles of all languages must conform to the general schema defined by Fig. 4: i.e., these constituents and their internal relations define the only possible variations. Just as a phrasal constituent is assumed to be based on a categorial head (the *X* of a constituent *X'*), a syllable also has a head: its nucleus. I assume, that is, that every structural syllable must have a nucleus, though there may be considerable variation in whether onsets and margins are obligatory, optional, or prohibited.

I assume, finally, that syllabic structure is present at all levels of a phonological representation. We do not provide underlying representations in solely segmental terms, and then (perhaps at some rather late point) impose a syllabic organization on them by rule. Of course, the syllabic organization of any given string of segments has a considerable degree of predictability; but this can be captured perfectly well within the grammar of any particular language by a set of syllable-structure rules such as those alluded to in the preceding paragraphs. Even if a language allows completely unique syllabifications of every admissible segment string, this does not imply that the simultaneous presence of both kinds of organization in representations results in any pernicious redundancy, given a suitable expression of the principles involved. Of course, much of the segmental organization of a string is similarly predictable from its component features; but this has not generally led linguists to propose that representations should be given in terms of some kind of unstructured 'feature soup' that is organized into segments at an appropriate intermediate stage of derivations.

Rules can manipulate either segmental or syllabic organization, just as they can alter the feature composition of individual segments. In the description of some rules of French below, examples will be presented of rules that alter syllabic organization without affecting (directly) the segments themselves. It is to be anticipated that a suitable view of such processes can lead to a corresponding limitation on the possible effects of strictly segmental rules: for instance, there is reason to believe that segmental rules of epenthesis can be completely prohibited, and that processes of 'compensatory lengthening' (cf. de Chene & Anderson 1979) can be severely restricted.

5. SYLLABLE STRUCTURE AND THE TREATMENT OF SHWA. In §§1–3 above, I introduced the motivation for assuming that a phonological entity traditionally called shwa exists in the vowel inventory of French, and discussed some of its important properties. We saw that at least one of these (the alternation with phonetic [ɛ]) appeared to depend on syllable structure. In §4, I presented a view of phonological and phonetic structure that treats syllables, as well as segments, as structural units. We now go on to explore the extent to which such syllabic structure can help provide an account of other properties of shwa.

Basically, what we know about shwa is that (a) when it appears phonetically, its value is [œ]; (b) unlike instances of [œ] that derive from underlying /œ/, it does not alternate with [ø] in final position (except, as noted above, in postposed *le* for some speakers); (c) under specified circumstances, it is deleted (i.e., it alternates with Ø); (d) under other specified circumstances, it alternates with [ɛ]; (e) unlike other vowels, it does not take stress when in final position in polysyllabic words; and (f) before words of the *h*-aspiré class, it is preserved under the syntactic conditions characteristic of elision and liaison environments (obligatorily in monosyllables, optionally in polysyllables), rather than being deleted obligatorily by one of the shwa-deletion rules or by the normal rule of elision.

The first issue which I now wish to raise is the underlying representation which shwa should have. As noted above, previous treatments of French have proposed no real solution to this problem. Phonetically, the only motivated representation of shwa is as [œ]; but this is impossible, since shwa must be distinguished from 'stable' /œ/. The choice of any phonetically interpretable feature for this purpose (e.g. [±advanced tongue root] or [±tense]) would be arbitrary, since shwa is not phonetically distinct from /œ/. It would not be sufficient to employ a rule feature, for two reasons: (a) Not all instances of [œ] in a word need be categorized in the same way, as 'stable' vs. 'unstable' /œ/, since shwas and 'stable' /œ/ can co-occur (e.g. in *demeurer* 'to remain'), while it is normally assumed that the domain of a rule feature is an entire formative, rather than a single segment. (b) Several distinct properties characterize the difference between shwa and /œ/, and these go together. Since there are no instances of 'shwas' that, e.g., are deleted but do not alternate with [ɛ] when the conditions for that rule are met, it would be inappropriate to distinguish the two vowels simply by rule exception features; i.e., the shwa-deletion rules have nothing to do with the shwa-[ɛ] rule, the /œ/-[ø] rule, the location of stress etc. However, exceptionality with respect to one of these apparently implies exceptionality with respect to the rest. This could be captured if we had some way to represent shwa as a unit distinct from /œ/, but it is missed if we rely on rule features to describe the difference. The alternative possibility of representing shwa as /œ/ with some arbitrary diacritic (i.e. as /œ'/) is surely to be avoided, both on general grounds and because this diacritic would have to be referred to by a number of distinct rules.

When presented with an alternation between two phonological units *A* and *B*, the natural choice for an underlying representation (though there may be others) is either as /A/, with a rule converting /A/ to [B] under some circum-

stances; or as /B/, with a rule to convert /B/ to [A]. In French, the element in question involves an alternation among [œ], [ɛ], and Ø. We have already seen, however, that neither /œ/ nor /ɛ/ is a possible underlying value for shwa, since both of these vowels are independently part of the phonological system of French. The only remaining possibility, then, would seem to be Ø; but the argument of Dell 1973 was cited above to the effect that shwa cannot be regarded as epenthetic in all its occurrences.

Note, however, that what Dell's argument showed was that the structural position in which shwas occur is phonologically distinctive; but what is at issue here is the set of phonological features associated with this segment. Of course, on the traditional view (in which a segment is identified with a particular complex of features), there is no way to indicate the presence of a segment without assigning it any features. In terms of the syllabic representations introduced in §4, however, this is no longer the case. That is, if we were to represent shwa as a structurally-present syllabic nucleus with NO ASSOCIATED PHONOLOGICAL FEATURES, we could overcome Dell's argument against epenthesis, but still treat shwa as a sort of underlying /Ø/. On this view, e.g., the word *cheveu* 'hair' would be represented as in Figure 5.⁴

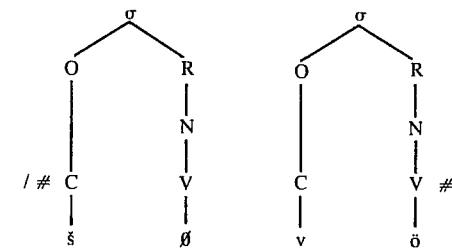


FIGURE 5.

Such a representation relies on the fact that a structurally-present syllable must (by virtue of universal constraints noted above) contain a nuclear position. Syllables with 'shwa' in French are then treated as analogous to 'empty nodes' in syntactic representations: elements which are structurally present, but to which no designated content is assigned in underlying form.

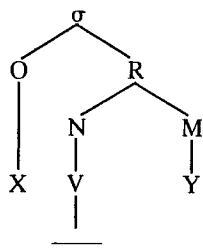
Given such a representation for shwa, we can now distinguish such syllables from those containing 'stable' /œ/ by the fact that only the latter have the features [-back, -high, -low, +round] etc. associated with their nuclear segment in underlying structure. Of course, this phonetic value must be supplied for shwa syllables as well, insofar as their vowels are to be pronounced. I assume this is done by a comparatively late rule of 'Shwa Spelling' which

⁴ I assume that boundary elements (# and +) are interspersed with segmental units. Though only segments form constituents of syllables, the boundaries which separate them may come to be included (non-significantly) within particular syllables by virtue of the inclusion within a given syllable of the segments on either side of an individual boundary.

can be formulated as follows:

$$(6) \emptyset \rightarrow [-\text{back}, -\text{high}, -\text{low}, +\text{round}] \text{ etc. } / [\sigma \text{ X } [\text{N } ____] \text{ Y}]$$

This rule states that (regardless of the content of the rest of a syllable), if its nucleus is unfilled, this segment is assigned the features of [œ]. The rule might also have been formulated as follows:

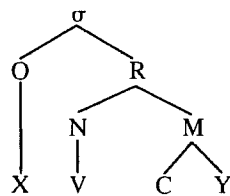


$$(7) \emptyset \rightarrow [\text{œ}] / ____$$

The operation of this rule can be regarded as analogous to that of one inserting *it* in the position of an extraposed complement, or *there* in sentences like *There is a shwa in this form*.

Note that the decision to represent shwa as a sort of underlying / \emptyset / is not an arbitrary one. Of course, whenever one has a difficult problem in choice of underlying representation, it can in principle be resolved arbitrarily; but in the present case, the choice of / \emptyset / is motivated in part by the fact that this is, after all, one of the important surface variants of the vowel in question. In the choice of representation for a vowel which displayed, say, exactly [œ] and [e] as its surface variants, / \emptyset / could not be chosen; and if we had more than one phonemically distinct vowel alternating with \emptyset , the / \emptyset / representation would be insufficient to distinguish them from one another (and at the same time from presumed 'stable' vowels with the same quality). Thus the range of cases in which this option is open to us is limited and principled.

Now that we have decided on a representation for shwa, and have a way of referring to syllable structure, we can return to formulate the rule of Closed Syllable Adjustment which is responsible for the [e]–[ɛ] and shwa–[ɛ] alternations. This can be shown as follows:



$$(8) (\acute{e}) \rightarrow [\text{ɛ}] / ____$$

$$\text{a. } \acute{e} \rightarrow [\text{ɛ}]$$

$$\text{b. } \emptyset \rightarrow [\text{ɛ}]$$

Note that the structural description of this rule contains an expression in parentheses; in accord with the interpretation of the parentheses notation elsewhere in phonology, I assume that this is interpreted as a schema abbreviating two rules, one in which the parenthesized material is present, as in (a), and one in which it is absent, as in (b). The structural description of the rule specifies that the change takes place in the nuclei of syllables whose margins contain at least one (consonant) segment—the traditional characterization of closed syllables.

Thus far, the notion of syllable structure has provided us with a way of representing shwa, and a way of specifying succinctly the environment of the rule of Closed Syllable Adjustment. Moving on to the other properties of shwa, I can suggest that the proposed representation of this element is essentially involved in characterizing the facts of shwa deletion. Note that, on my analysis, syllables containing shwa have specified phonological material associated only with non-nuclear positions. Let us assume that a rule of French has the property of deleting entirely any syllable which, at an appropriate level of a derivation, contains no specified material whatever:

$$(9) [\sigma \emptyset] \rightarrow \emptyset$$

Such a rule has an obvious sort of motivation, and I might suggest that it is fundamentally responsible for all instances of shwa deletion. If we could formulate other principles of French phonology which would have this consequence, we would have progressed toward associating the phonological character of shwa with the fact of its deletion; i.e., we would have an account that came closer to explaining why it is exactly shwa, rather than some other arbitrary vowel, that is subject to a wide range of deletion processes.

Given the existence of a rule like 9 to delete unjustified syllables (i.e. those with no phonological content) at some point in a derivation, we can view the facts of shwa deletion in a non-traditional way. On this approach, the rules in question do not directly DELETE the shwas, but rather have the function of 'evacuating' the (consonantal) content from certain syllables. If a rule has the effect of resyllabifying the consonant(s) of a syllable containing shwa, so that they are now associated with some other syllable, the result will be to convert the original shwa syllable into an unjustified one which is subject to deletion by rule 9. As will be seen below, this approach has some merit in resolving problems that arise in the standard view which deletes shwa directly.

To see how such an approach would work, let us consider the first of the shwa-deletion rules introduced in §2 above: rule 1, or Final Deletion. This rule was responsible for deleting final shwas (in positions other than before *h*-aspiré words, a condition to which I will return in §6 below). In terms of the approach being considered here, this rule would be reflected as follows:

$$(10) \begin{array}{ccccccc} [\sigma & C_0 & V & C_0] & [\sigma & C_0 & \emptyset] & \neq \\ & 1 & 2 & 3 & & 4 & 5 & 6 \\ \Rightarrow & [\sigma & 1 & 2 & 3+4] & [\sigma & 5] & 6 \end{array}$$

This rule is stated in the 'classical' format for the description of transformations, which seems appropriate in light of its function as rearranging a structural

configuration. Of course, an adequate theory of rules operating on syllable structure must be much more restrictive than is implied by the formal possibilities of this notation. The development of such a theory might allow for only a small inventory of structural possibilities: ideally, perhaps only 'Resyllabify α ', analogous to the proposed rule 'Move α ' in syntax. Since it is not my purpose here to propose such a more restrictive theory, but rather to argue for the basic importance of such structure-sensitive processes as 10, I will continue to use the more general formalism without intending thereby to claim that it accurately characterizes the range of possible rules.

Rule 10, then, has the function of removing the consonantal onset from a syllable whose nucleus is empty and which is followed by an instance of word boundary, and of re-associating this material with the preceding syllable. As a consequence, the final syllable has no remaining phonological material; it is thus subject to deletion by rule 9. The derivation of a word such as *petite* would thus look like Figure 6.

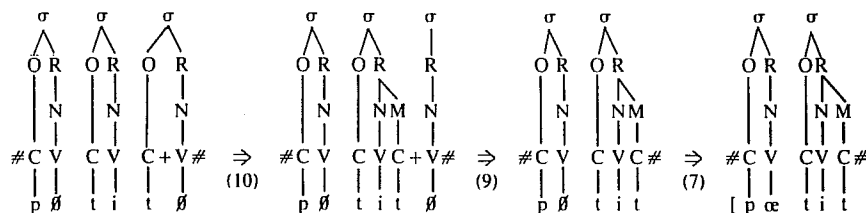


FIGURE 6.

I assume that underlying representations are syllabified in accord with some general principles (in part also language-specific). In particular, the usual assumption is made that single intervocalic consonants are associated with the following syllable, rather than the preceding one. As noted above in fn. 4, I also assume that boundary elements (+, #) are present in the string of segmental units, though they are not themselves associated with a particular syllable. In Fig. 6, the underlying representation thus provided is first affected by rule 10, which re-associates the /t/ of the final syllable with the penult (thus providing the latter with a margin); rule 9 subsequently deletes the (now empty) final syllable, while the initial syllable—which contains material in its onset, and thus is not subject to deletion by 9—has the features of [æ] associated with its (underlyingly empty) nucleus position. This results in the correct surface phonetic form [pætit].

Rule 10, then, functions primarily to render a final syllable subject to deletion by rule 9, by evacuating its consonantal onset if its nucleus is already empty. We can, however, note an additional, independent justification for rule 10. The usual treatments of Closed Syllable Adjustment (e.g. Dell 1973, 1980, Selkirk 1972) need to make a special provision for cases in which a vowel subject to adjustment is followed by exactly one consonant which is itself followed by certain shwas. That is, on the general view of the morphology of French assumed here and in those works, the 3sg. present tense of a verb like *acheter* 'buy' ends in a shwa (whose motivation is to 'protect' the final /t/ of the stem

from truncation). The form *achète*, i.e. [aʃet], is thus assumed to be phonologically /aʃet + ə/. In this form, however, the shwa of the penultimate syllable is not subject to Closed Syllable Adjustment (rule 8 above) under the normal assumptions about the syllabification of single intervocalic consonants.

One might attempt to resolve this problem by ordering the rule of Closed Syllable Adjustment after the rule deleting final shwas: after the final shwa of /aʃet + ə/ is lost, the form is /aʃet/; the shwa which remains is now in a closed syllable, and thus subject to rule 8. This solution will not work, however. In a form like *cachet* [kaʃe] 'seal, stamp', the underlying form must contain a shwa in its final syllable, as shown by the related verb *cacheter* [kaʃte] 'to seal up', followed by a /t/. The underlying form is thus /kaʃet/; the shwa is converted to [e] by rule 8 by virtue of being in a closed syllable, and the final /t/ subsequently is truncated. However, in order for this natural account to work, we must assume that Closed Syllable Adjustment precedes truncation. The loss of final shwas, of course, must follow truncation, since many of them function to protect final consonants from the effects of that rule (e.g. *il cachète* [ikaʃet] 'he seals up', from /kaʃet + ə/). The loss of final shwas in such a form, then, must clearly follow the operation of Closed Syllable Adjustment: we cannot appeal to closed syllables created by the loss of these vowels to permit the operation of the later rule.

To deal with this problem, previous treatments have assumed that the notion of a 'closed syllable' which is relevant in French is more complex than that specified in the structural description of rule 8 above. In particular, an analysis like that of Dell 1980 considers a vowel to be in a closed syllable if it is followed by at least one consonant which is either (a) final in a word; (b) part of a cluster, except when that cluster consists of an obstruent followed by a liquid; or (c) followed by a shwa which is itself followed by a boundary. Final consonants will, of course, close their syllables on any analysis. If we assume that the beginnings and ends of clusters are in general assigned to different syllables, except in the special case of those clusters which can appear in syllable-initial position (in particular, obstruent + liquid), then vowels followed by clusters will either meet the description of rule 8 or not, depending on the content of the cluster—without further stipulation in that rule. Most interestingly for present purposes, however, single consonants followed by a shwa, if followed in turn by a word boundary,⁵ will be assigned to the margin of the preceding syllable by rule 10; thus this class of complications to the notion of 'closed

⁵ In Dell's analysis, not only # but also some instances of + may create a 'closed syllable' when they follow a shwa. The instances of shwa followed by + that are in question are all cases of 'thematic shwa', i.e. ones in which the shwa is both preceded and followed by +. I assume (though I do not go into further detail here) that a separate rule, similar to 10 in its effects, assigns a consonant to a preceding syllable if it forms the onset of a syllable whose nucleus is such a thematic shwa (i.e., /... V/ [_, C + ə + ...] is resyllabified as /... VC/ [_, + ə + ...]). This will, of course, convert the syllable preceding a thematic shwa to a closed one.

Another detail of Dell's analysis which requires comment is his proposed restriction of 'Closed Syllable Adjustment' to cases in which the affected vowel and the following consonant are not separated by a morpheme boundary. This restriction, if necessary, would substantially weaken the theory of phonological boundary elements; but fortunately, as Basbøll has shown, reasonable assumptions about the morphology of the language make it unnecessary.

'syllable' can also be removed from the description of rule 8. In fact, this move is necessary in order to preserve the traditional notion of 'closed syllable', quite apart from the facts of final shwa DELETION. The facts of Closed Syllable Adjustment thus provide independent support for the resyllabification performed by rule 10, and thus for the correctness of this rule.

Passing on to the cases of shwa deletion by the two VCE rules posited in §2, recall that these both had the effect of deleting a shwa preceded by a single consonant and another vowel. On the present analysis, we could achieve the same effect (observing that such a single consonant would regularly be syllabified with the following shwa) by re-assigning a single consonant in the onset of a syllable with empty nucleus to the rhyme (and thus margin) of the preceding syllable.⁶ We might reformulate rule 2 (Internal VCE) as follows:

$$(11) \quad \begin{array}{c} V]_{\sigma} \quad [_{\sigma} C \emptyset] \\ 1 \quad \quad 2 \quad 3 \\ \Rightarrow 1+2]_{\sigma} [_{\sigma} 3] \end{array}$$

We do not, of course, need to take into account the possibility that the syllable containing shwa which undergoes this rule has a non-null margin—since, if it did, rule 8 would convert the nucleus to [ɛ]. The result of applying rule 11, then, will be to 'evacuate' the syllable with shwa, rendering it subject to deletion by rule 9. The result of deleting the shwa is thus achieved as a consequence of the resyllabification described by rule 11.

External VCE is formulated in an analogous fashion, of course, rule 3 being replaced by the following:

$$(12) \quad \begin{array}{c} V]_{\sigma} \neq [_{\sigma} C \emptyset] \\ 1 \quad 2 \quad 3 \quad 4 \\ \Rightarrow 1 \quad 2 \quad 3]_{\sigma} [_{\sigma} 4] \end{array}$$

As in the original analysis for rules 2–3, we need to state that External VCE (rule 12) is optional; but that the internal rule (11) is obligatory wherever it is applicable, after 12 has had a chance to apply.

Before returning to these conditions, however, let us note that the view of VCE as following from resyllabification immediately resolves our earlier dilemma about the way in which overlapping instances of the rule should apply. Recall that the problem was to ensure that shwas in adjacent syllables were never deleted. On the analysis being developed here, a shwa is 'deleted' when

⁶ Note that, in certain cases where a consonant is made part of the margin of a preceding syllable (e.g., in order to trigger Closed Syllable Adjustment), it must eventually leave this margin and become again the onset of the following syllable—if the generalization suggested by Delattre, that French syllables are always open (when possible), is correct. More work remains to be done to determine the character of surface syllabification in French, but it appears that a rather general principle associating consonantism with a following phonetic vowel (where possible, subject to general conditions on possible clusters in French) operates to determine the structure of actual surface forms. The principle in question would be quite a natural one—in fact, essentially the same as a principle determining the syllabic structure of underlying forms. By virtue of its operation, it is clear that the rules developed in this paper which depend on and manipulate syllable structure refer to a PHONOLOGICAL construct which does not need to be directly equivalent to surface syllabification in any particular, measurable sense.

it represents a syllable with no phonological content. Now suppose we have an instance of two adjacent syllables containing shwa, subject to VCE. If we do not resyllabify the (single) consonant which separates the two nuclei in question, the second syllable will of course be preserved, since its onset will be non-empty. In order to delete it, we must resyllabify this consonant with the preceding vowel by one of the VCE rules; but once we do this, the PRECEDING syllable is no longer subject to deletion, since its margin is now non-null. The restriction that adjacent shwas not be deleted thus follows directly from the fact that a consonant between two shwas must be syllabified with one or the other of them; and whichever is associated with the consonant is, ipso facto, preserved from the effects of deletion by rule 9. To return to expressions with a number of successive shwas subject to External VCE, we can see that any of the re-associations indicated by dotted lines in Figure 7 can be made (thus breaking the indicated solid association), but in each case the fact of preparing one shwa for deletion necessarily preserves the preceding one.

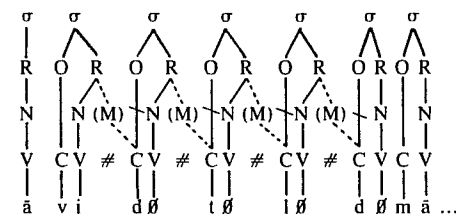


FIGURE 7.

While this analysis thus solves the problem of how to prevent the deletion of adjacent shwas, another problem is apparently created. Suppose, for example, we were to choose to apply rule 12 in ALL the places where it is potentially applicable in Fig. 7 (*envie de te le demander* 'desire to ask you it'). The result of this would be to resyllabify all the consonants in accord with the dotted lines in Fig. 7. This would have the effect of evacuating the first syllable of *demande*, thus causing it to be deleted; but every other syllable would gain a consonant to compensate it for the one it lost. We would therefore have performed a number of resyllabifications with vacuous effects. More perniciously, perhaps, we would be predicting the potential existence of phonetic differences in syllabification for which there is no support. This difficulty could be resolved at the phonetic level by invoking the principle of 'forward resyllabification' referred to in fn. 6 above: such a principle is independently necessary to accommodate the facts of *h*-aspiré words, in any event. Before this class of words, as we will see below, shwa is not generally dropped; but this is not directly related to any presumed failure of a rule like VCE to apply. If VCE does apply in a form like *pas de housse*, forward resyllabification must apply to re-attach the *d* of *de* to the following (undeleted) shwa.

Forward resyllabification would thus eliminate the unnecessary alternative forms at the phonetic level; but the difficulty would persist phonologically. Conceivably, we might expect the shwas that have been provided with syllable-

final consonants to behave as if they were in closed syllables (and thus undergo conversion to [ɛ] by rule 8). No such effect is observed, however; so we must specify (as is indeed required by any analysis) that Closed Syllable Adjustment is a comparatively early rule in relation to the rules of VCE.

Indeed, a certain class of forms, which has posed problems for previous analyses, suggests that the rule of Closed Syllable Adjustment must in fact re-apply to (essentially) surface forms. Consider a form like *élever* 'raise': from the underlying /eləve/, we would expect to derive the phonetic form [elve] by the application of VCE (together with the deletion of the resulting empty second syllable by rule 9); and this is indeed a possible pronunciation of this word. But another possible pronunciation, [elve], is more problematic. This form appears to have undergone Closed Syllable Adjustment to convert the initial /e/ to [ɛ]; but the conditions for that adjustment would not be met until VCE has shifted the /l/ of the second syllable into the first, thus closing it. As we have just seen, however, Closed Syllable Adjustment must precede, not follow, VCE.

These facts have led other investigators (e.g. Selkirk 1972, Dell 1973) to posit a late rule of quality adjustment applying only to the vowel /e/, converting it optionally to [ɛ] in (the equivalent of) surface closed syllables. The similarity of this rule to Closed Syllable Adjustment, already formulated, would lead one to prefer an analysis in which pronunciations such as [elve] are derived by the (optional) re-application of the latter rule; but such a step is apparently precluded by the fact that Closed Syllable Adjustment is applicable both to /e/ and to shwa, while only /e/ is subject to 'late adjustment'.

Note now that our analysis allows us to identify 'late adjustment' with Closed Syllable Adjustment (rule 8). That rule, it will be recalled, applies to closed syllables whose nuclei are either /e/ or null. However, null nuclei which are not deleted are converted to [œ] by rule 7. If we assume that 'late adjustment' consists in the re-application of Closed Syllable Adjustment AFTER rule 7 has already supplied this phonetic value for null nuclei that do not undergo deletion, we have an immediate explanation for the failure of shwa to undergo late adjustment: rule 8 is not applicable to syllables containing [œ], the surface form of shwa. Thus 'late adjustment' forms like [elve] provide an additional point in favor of the present analysis of shwa as an underlyingly null nucleus (subject to adjustment by rule 8) which is either deleted or converted to [œ] (and thus not subject to rule 8 on the surface).

Let us return, however, to the question of whether VCE should be allowed to perform vacuous resyllabifications. We have seen that there is no direct evidence against such resyllabifications; but there is also no evidence in support of them, and we might well want to eliminate this possibility. The answer would appear to come from the nature of the syllables that the undesirable applications would create. That is, it is admissible to provide a shwa syllable with a margin so long as it preserves its (original) onset; but if the onset is lost, a margin should not be assigned. Thus the cases we wish to prevent are instances of rules 11–12 that would create syllables with no onset, an empty nucleus, and

a non-null margin. But the inadmissibility of such syllables in fact follows from an independent fact about French, noted above: the vowel shwa cannot be INITIAL in a syllable. This is true for forms which remain unchanged from their underlying representations, as well as those that are (potentially) affected by rules such as VCE. We could specify, then, that French forms are subject to a general filter of the following form:

$$(13) *[\sigma [\text{N } \emptyset] X] \quad (\text{where } X \neq \emptyset)$$

This filter serves to block any application of a rule which would otherwise create shwa-initial syllables, except in the special case of syllables with no margin (which are then subject to deletion by rule 9). As a result, there is no need to specify further the prohibition against 'vacuous' applications of rules 11–12.

We can now observe that the same filter will also constrain the interaction of rules 11–12. Consider again a form like *tu devenais* 'you became'. The first shwa of this form is subject to deletion by External VCE, and the second by Internal VCE. Assuming that the external case applies optionally and first, it may or may not resyllabify the *d* with the preceding vowel. If it does not, the obligatory internal rule will resyllabify the *v* with the preceding syllable—resulting in the eventual deletion of the second syllable of *devenais*, giving the pronunciation [tʰdœvne]. But suppose the external rule does apply, associating the *d* with the preceding /ü/. Now, when the internal rule is considered, the only way it can apply will be to associate the *v* with the (now onset-less) initial syllable of its word; but this would create a syllable that would violate filter 13. Thus the application of 11 is blocked; and the only syllable that can be deleted is the first—giving the other possible pronunciation of the form, [tʰdœvne].

We see, then, that a fairly limited and natural set of principles can account for the behavior of French shwa in a natural fashion, without requiring complex theoretical principles for the application of rules. The principles involved are based on the representation of shwa as a structurally present, but phonologically unfilled syllabic nucleus. They include rule 9, which deletes syllables that have no phonological content whatever; rules to resyllabify consonantal onsets out of shwa syllables, thus feeding rule 9, under the conditions of Final Deletion and VCE; a simple and straightforward statement of the form of Closed Syllable Adjustment; and a general filter which disallows non-null shwa-initial syllables (and which has independent motivation in the language's general prohibition of initial shwa). While it has not been possible to develop all the details of the analysis and related points within the limited scope of this paper, their consideration does not appear to impugn these basic principles in any way; and so far as is known, all the ancillary facts cited in the literature to date can be incorporated into this analysis without significant change. Before concluding, however, I go on to develop some further consequences of the treatment of shwa and its behavior introduced above, as well as a characterization of words of the *h*-aspiré class.

Second, rule 16 has been written with a second instance of #, parenthesized, in the environment. This might appear unnecessary: after all, any obstruent which is followed by two instances of # is also followed by one, so it would appear that only one needs to appear in the rule. The point of this complication is to provide a way of representing the fact that a few words are exceptions to Final Consonant Deletion in phrase-final position, but not before consonants. Thus, in *un oeuf* [œnœf] 'an egg', the final /f/ is preserved; but in *des oeufs* [dezø] '(some) eggs', both the final /f/ and the final /z/ of the plural are deleted. I account for this by the assumptions (a) that the plural marker is separated

from the preceding word by a word boundary (#);⁸ and (b) that words like *oeuf* 'egg', *boeuf* 'ox', *os* 'bone' etc. are exceptions with respect to the longer sub-rule abbreviated in rule 16 (i.e. in the environment before ##), but not with respect to the shorter. That is, no deletion takes place in /##œf##/ because the word is an exception to deletion before ## (and the principles of disjunctive order—as outlined in, e.g., Anderson 1974—prevent the application of the shorter rule when the structural description of the longer rule is met); but the /f/ in /##œf#z##/ is deleted by the shorter sub-rule, while the final /z/ (which is not exceptional at all) is deleted as usual by the longer sub-rule. The unusual behavior of words like *oeuf* requires some mechanism in the grammar for its statement; the inclusion of an additional instance of # in rule 16 provides a way of doing this in terms of a simple exception feature.

In addition to the facts of Final Consonant Deletion, described by rule 16, it is also the case that certain final vowels are lost in French. In particular, shwa is lost when separated from a following vowel-initial word by at most one word boundary (cf. Dell 1980:177 ff., 233).⁹ In formulating this rule, we can note also that the consonant which precedes the shwa is, as a consequence of the elision, syllabified with the following vowel: thus, in *l'aigle* [legl] 'the eagle', from /###læ#εgl##/, the /l/ of the article becomes the onset of the first syllable of *aigle*. We can incorporate this resyllabification into the same process that performs the deletion:

$$(17) \quad [\sigma X (C) [N \emptyset]] (\#) [\sigma V X]$$

$$\begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \\ \Rightarrow [\sigma 1] & [\sigma 2] & \emptyset & 4 & 5 & 6 \end{array}$$

Having formulated elision thus, we can note that it bears some similarity to rule 15 above—as is indeed appropriate, given that both elision and enchaînement

⁸ Selkirk 1972 and Dell 1980 argue that the plural ending (as well as other instances of morphemic /z/ and /t/) cannot be regarded as separated from what precedes them by #, but rather that the boundary must be +. The argument hinges on the fact that the sequence /al/ is replaced by [o] when followed by a consonant belonging to the same word. Since the plural /z/ and the 3sg. ending /t/ (as well as other instances of morphemic /z/ and /t/) cause this change, but a following consonant-initial word in liaison context does not, it is necessary to be able to distinguish these two circumstances in which the sequence /...al#C.../ can arise. On a strictly segmental view, this is indeed a problem; but on my approach, it is easy to resolve. The rule changing /al/ to [o] applies when another consonant follows /l/ IN THE SAME SYLLABLE, rather than in the same word. This rule applies before the resyllabification processes of liaison (described by rule 15)—as is entirely natural, given its somewhat abstract character. Such a restriction of the /al/ > [o] rule to 'closed syllables' makes more phonetic sense than the statement given by Selkirk and Dell, besides allowing the present analysis to work.

⁹ Besides shwa, elision also affects the /a/ of the article and pronoun /la/: the /i/ of the complementizer (but not the question word) *qui*; the /ü/ of the subject pronoun *tu* in informal speech; and the /i/ of *si* 'if' in the specific combination *si il* (= *s'il*). I assume that the /a/ of /la/, the /i/ of *qui*, or (optionally) the /ü/ of *tu* is reduced to shwa before another vowel by a minor rule or lexical suppletion, and that the specific combination *s'il* is lexicalized. Alternatively, one could observe that words like *mon/ma*, with suppletive masculine and feminine forms, show the masculine form (*mon*) in the feminine before a vowel (*mon amie* 'my girlfriend'). One might propose on this basis that the distinction *le/la* is similarly neutralized in favor of the masculine in this position. This latter account does not generalize naturally to the behavior of *qui*, *tu*; but the first proposal above,

perform resyllabification of a consonant with the initial vowel of a following syllable. We can in fact collapse the two rules into a single schema:

$$(18) \quad [\sigma X (C) [N \emptyset]] (\#) [\sigma V X]$$

$$\begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \\ \Rightarrow [\sigma 1] & [\sigma 2] & \emptyset & 4 & 5 & 6 \end{array}$$

This rule performs the resyllabification which is characteristic of enchaînement, together with the deletion of a null syllabic nucleus ('elision') if it is present.

We return now to the class of *h*-aspiré words, referred to in various places above. The primary characteristic of these words, as has often been noted in descriptions of French, is the fact that they begin (phonetically) with a vowel, but 'act as if' they begin with a consonant. That is, a word like *hoquet* 'hiccup' is phonetically [ɔkɛ], and we would thus expect elision to apply before it; but in fact, instead of **l'hoquet* [lɔkɛ] 'the hiccup', parallel to *l'hôpital* [lɔpital] 'the hospital', we have *le hoquet* [ləkɛ]. Furthermore, though elision does not apply before this class of words as expected, Final Consonant Deletion DOES apply—a fact which is equally unexpected, given that they appear to be vowel-initial. Thus *un petit hoquet* [œpœtiɔkɛ] 'a little hiccup' shows loss of the final /t/ of *petit*, rather than its preservation in liaison which we would expect, giving *[œpœtiɔkɛ] (parallel to *un petit hôpital* [œpœtitɔpital] 'a little hospital').

Various solutions have been proposed to the problem of analysing the *h*-aspiré class. One possibility, suggested by Schane 1968 and Dell 1970, is to represent them with some underlying abstract initial consonant, which will serve to block elision and to trigger Final Consonant Deletion (like any other consonant)—and which is subsequently deleted. But there are several difficulties with this analysis. First, the abstract consonant in question is one for which there is no direct evidence whatever, and thus one whose features are completely indeterminate (beyond the fact of being [–syllabic], and being distinct from all other consonants). Such an arbitrary choice of analyses should probably not be possible in phonological descriptions. Second, the consonant in question has a seriously defective distribution: unlike the other consonants of French, it appears only initially. Again, this is an undesirable complication of the analysis. Finally (as pointed out by Dell 1970, Tranel 1981), no words in the *h*-aspiré class begin with shwa. This will of course be a direct consequence of the fact that no vowel-initial words in French begin with shwa, if *h*-aspiré words are analysed as beginning with a vowel; but if they are treated as beginning with a consonant, the restriction is arbitrary (and might even be construed as complicating the constraint against shwa in initial position, depending on the rest of the analysis). Such a solution, involving an initial abstract consonant, is thus not a very desirable one.

An alternative view, suggested by Kiparsky 1973a, involves representing *h*-

the essence of which is to delete the phonological features of the vowel of these items before another vowel, does not generalize to *mon/ma*. No completely satisfying solution to this problem is evident; however, the only vowel which must apparently be mentioned by the elision rule is shwa.

aspiré words with initial vowels, but preceded by a special boundary (perhaps an additional instance of #). This solution avoids the arbitrariness of the 'abstract consonant' solution, but at the cost of obscuring the difference between segments and boundaries as constituents of phonological forms. In addition, as will be seen below, it does not provide a complete account of the peculiarities of *h*-aspiré words, any more than the 'abstract consonant' solution does.

Yet another alternative is to represent words of the *h*-aspiré class with an initial consonant, but (on the analogy of the treatment proposed here for shwa) assign no phonological features to this consonantal position. If we assume that such an unfilled consonant position is simply deleted in phonetic structure, we can then use it to account for the elision/liaison behavior of the words of this class. Note, however, that this solution fares no better than any other 'abstract *h*' analysis in accounting for the failure of shwa to be deleted before *h*-aspiré words. We can see that this failure of shwa deletion and the facts of elision/liaison are linked, in that the same syntactic conditions which govern elision/liaison also define the environment for the non-loss of shwa before *h*-aspiré. No property of the abstract consonant (whether empty, as on this account, or specified, as on earlier views) has any apparent relation to the facts of shwa deletion.

On the account developed above, however, we have a straightforward description of the words of this class. Since they do not condition elision, they must fail to undergo rule 18. If we represent them in the most direct way possible, they will be vowel-initial forms: they are then simply marked as exceptions to rule 18. In that case, it follows automatically that Final Consonant Deletion applies before them. This is because rule 16, which deletes final obstruents before #(#), will apply to any final consonant UNLESS it is resyllabified from the margin of its underlying syllable into the onset of the following syllable. This resyllabification is performed by rule 18, the generalized enchainement rule; thus the fact that *h*-aspiré words are exceptions with respect to conditioning the application of that rule (as motivated by elision) will have the consequence that they will allow the deletion of a preceding final consonant. Thus the single exception feature, referring to rule 18, will describe both these aspects of *h*-aspiré words, without invoking any abstract consonant or unusual boundary.

Another property of *h*-aspiré words can also be provided for in a natural way in the analysis developed above. Recall that, on the standard account (cf. Dell 1980), a number of distinct rules in the phonology have the function of deleting shwa. Each of these, as has been noted above (and as could be shown for such additional shwa-deletion processes as have not been discussed here), has the peculiarity that it fails to apply when the shwa in question is followed by a word of the *h*-aspiré class. On the standard analysis, this exceptional behavior must thus be built into the statement of each process of shwa deletion, since no general mechanism exists in phonology for the statement of this sort of 'global exceptionality'. On the account developed here, however, this problem does not arise. That is, this analysis has only a single rule deleting shwa: rule 9 above, which eliminates empty syllables. A number of other processes (each

corresponding to a shwa-deletion rule on the standard analysis) feed this rule, but they do not themselves delete shwas.

On this analysis, only rule 9 must be characterized as failing to apply before *h*-aspiré words. Even though a shwa syllable may come to be otherwise without phonological content, if it is not deleted by rule 9, its nucleus will be supplied with the phonological features of [æ] by rule 7, and it will thus be pronounced like any other (non-'deleted') shwa. My analysis thus derives some additional support from the fact that it provides, without invoking additional mechanisms, a single place in which to state the global property of *h*-aspiré words (i.e. that no rule can lead to the deletion of shwas immediately preceding them).

We can go further than this, however. Recall that *h*-aspiré words must be characterized as vowel-initial words that are exceptions to rule 18 above, in order to provide for their behavior with respect to the phenomena of elision and truncation. Now this generalized rule of enchainement is actually a schema, with a number of distinct sub-rules included in its expansion. One of those, corresponding to the case in which the pre-nuclear consonant is absent (and of course, the variable covering the remainder of the onset is null), is this:

$$(19) \quad [_{\sigma} [_{N} \emptyset]] (\#) [_{\sigma} V X]$$

$$\Rightarrow \quad \emptyset [_{\sigma} 2 \quad 3 \quad 4]$$

This is the special case of 'elision' that applies when the syllable in question contains no additional material beyond its empty nucleus. Observe, however, that this is a rule which deletes exactly an empty syllable which is followed by a vowel-initial word.

Now recall the nature of rule 9: this rule deletes exactly an empty syllable, without further conditions. Obviously, any syllable subject to deletion by rule 19 is also subject to deletion by rule 9, but not vice versa. As a result, however, the convention of disjunctive ordering which is defined with respect to a pair of rules, one of which is more specific than the other,¹⁰ should come into play here. Since rule 19 applies to a class of syllables that is properly included in the class satisfying rule 9, rule 19 should take priority over rule 9, and exclude consideration of it, with regard to syllables that satisfy its conditions (i.e. ones that are followed by a vowel-initial word). Normally, of course, this has no consequence: either rule will delete the syllable in question, and there is no way of knowing which rule was responsible.

The difference, however, comes from the fact that (as claimed above), words of the *h*-aspiré class are exceptions to the enchainement/elision schema 18—and thus to the special sub-case constituted by rule 19. If deletion by 19 takes precedence over deletion by rule 9, it should follow that forms which excep-

¹⁰ The principle of disjunctive order which is relevant here is the one (going back originally to Pāṇini) introduced in Anderson 1969; it was subsequently elaborated by Kiparsky 1973b under the name of the Elsewhere Condition (cf. also Anderson 1974, 1978). This replacement for the purely notation-based condition of disjunctive ordering proposed in *SPE* specifies that, when two rules conflict and one is 'more specific' than the other (in the sense of applying to a proper subset of the forms affected by the second), the first rule takes precedence over and precludes the application of the (more general) second rule.

tionally fail to condition 19 (even though they meet its structural description) would not allow deletion by rule 9 either. Of course, this is exactly what we sought to capture in the grammar in the first place: besides disallowing elision and causing truncation, the vowel-initial words of the *h*-aspiré class disallow the deletion of a preceding shwa. As a consequence, we can avoid an otherwise-unsupported global exceptionality mechanism to provide for the non-deletability of shwas before *h*-aspiré words: we need say NOTHING about them, beyond the single fact that they are exceptions to 18. This one exception feature has, as a unitary consequence, the totality of the various peculiarities of these words. This striking result provides overwhelming evidence for the correctness of the analysis of shwa given above. Note that, though analyses of the *h*-aspiré class which involve abstract initial consonants or boundaries CAN characterize the behavior of these words with respect to elision and liaison, they have no way to relate the presence of such a consonant (or boundary) to the non-deletability of preceding shwas—which must thus remain an unreduced and unexplained additional property of these unusual forms. On the present analysis, by contrast, there is no need to posit abstract consonants, rules of absolute neutralization, or globally-linked types of exceptional behavior. The *h*-aspiré words are described directly as beginning with a vowel (which is phonetically accurate), but as exceptions to exactly the one rule schema 18.¹¹ This is surely the optimal result.

7. CONCLUSION. We have concentrated above on some rules of French phonology which center around the treatment of shwa. A comprehensive treatment would require rules corresponding to those given by Dell 1980 for the elision of shwa before the marker of the future tense; for the treatment of final obstruent plus liquid clusters; for the elision of shwas in phrase-initial syllables, etc. In fact, straightforward accounts of these topics, as well as several others, can be incorporated quite naturally into the analysis given above; but they do not materially alter the treatment of shwa proposed here, and considerations of space prevent me from offering anything like a complete phonology of the language here.

The analytic framework of the above discussion rests crucially on the proposal that syllable structure is relevant and available for the operation of phonological rules, and that these rules can in fact manipulate it. This proposal has consequences, both for phonology in general and for the analysis of French, which go well beyond the treatment of shwa. To illustrate this point, I will discuss here briefly the phonology of nasal vowels.

¹¹ In addition, *h*-aspiré words must also be indicated as conditioning pre-consonantal, rather than pre-vocalic, forms of suppletive items: *mon/ma*, *cel/cet(te)*, *beau/belle* etc. One might suggest that, if the pre-vocalic form were to appear here, there would be a consonant to syllabify with the initial vowel of the following *h*-aspiré word—which would be impossible.

An alternative approach would be to assume that, for all such suppletive items, it is only the pre-vocalic form (*mon*, *belle*, etc.) which is inserted initially. If the rule of suppletion (replacing *mon* by *ma* in the feminine, etc.) follows the liaison rule (18), and requires that the item replaced still be a single syllable, then the behavior of *h*-aspiré words will follow without stipulation. It must be admitted that the order of rules involved here is unusual, and this solution remains to be worked out in detail.

Since Schane 1968, analyses in the 'standard' tradition have assumed that (at least many) nasal vowels in French are derived from underlying sequences of oral vowel plus nasal consonant. Alternations such as that in *plan* [plā] vs. *plane* [plan] 'even, level' (masc./fem.), *fin* [fē] vs. *fine* [fin] 'delicate' (masc./fem.), *brun* [brœ] vs. *brune* [brün] 'brown' (masc./fem.) etc. are thus derived straightforwardly from unitary underlying forms such as /plan/, /fin/, and /brün/. Of course, some non-alternating instances of nasal vowels may well be present as such in underlying forms, without altering this account. Sequences of vowel plus nasal, however, are replaced by nasal vowels when followed either by the end of the word (#) or by a consonant.¹²

Tranel 1981 has cataloged a number of forms in which this statement is apparently contradicted by the existence of basic sequences of /...VNC.../ which do not result in nasal vowels; but by far the largest class of these consists of words like *amnésie* ([amnezi]) 'amnesia', *indemnité* ([ēdemnite]) 'indemnity', *omnibus* ([ɔmnibüs]) 'omnibus' etc., in which the following consonant is a nasal.¹³ Since there in fact appear to be no instances in which a following nasal (not separated from what precedes by a # boundary) DOES cause nasalization, I conclude that what Tranel has noticed (apart from a few genuine exceptions like the slang word *hinse* 'mess', or borrowings like *week-end*) is a refinement which should be made in the rule, rather than a reason to believe it does not exist. We might state the rule (following Dell 1980:166, but incorporating the observation just noted) as follows:

$$(20) \quad \begin{array}{ccc} [+ \text{syll}] & [+ \text{nasal}] & \left\{ \begin{array}{c} [- \text{syll}] \\ [- \text{nasal}] \end{array} \right\} \\ \Rightarrow \quad \begin{array}{ccc} 1 & 2 & 3 \\ 1 & \emptyset & 3 \\ [+ \text{nasal}] & & \end{array} \end{array}$$

However, a problem arises for this rule from the facts of nasal vowels in

¹² I assume here a particular view of the process of learning involved in acquiring the phonology of French. In particular, I assume that the learner initially takes phonetic nasal vowels at their phonetic face value, and posits a phonological difference between oral and nasal vowels. Eventually, the existence of [VN]/[Ṽ] alternations leads to the positing of the rules suggested here, together with underlying forms in which /VN/ replaces earlier /Ṽ/. But if this replacement takes place item-by-item, with regard to the availability of evidence for it in particular cases, it would follow that alternating forms would be restructured with underlying /VN/, but non-alternating ones would not. This assumes that learning proceeds on the basis of positive evidence: the clearest kind of evidence available, perhaps, is that which comes from alternations, but in some cases evidence may be available from other sources (e.g., a systematic orthography may affect the underlying forms in the lexicon of a literate adult). For some discussion of the issue, cf. Anderson 1981. This view suggests that a generalization which is completely valid, but not supported by any alternations (such as the distribution of aspiration in English stops) is to be formulated as a constraint on possible forms—regulating the positions in which aspiration can and cannot appear—rather than as a rule (deriving, e.g., aspirated from underlyingly unaspirated stops).

¹³ Cases in which /VN/ becomes [Ṽ] before a nasal appear to be limited to words like *emmener* ([āmēne]) 'to lead away', *immangeable* ([ēmāzabl]) 'uneatable' etc., which involve prefixes (*em-*, *im-*). We must assume that these prefixes are followed by word boundary (#) when nasalized; for a survey of the relevant facts, cf. Tranel 1981.

liaison contexts. A number of words with nasal vowels have the property that, when they are in liaison before a word beginning with a vowel, a nasal consonant appears. Thus the indefinite article *un/lune* 'a' (masc./fem.) appears with a nasal vowel followed by a nasal consonant in forms such as *un enfant* [œnāfā] 'a child'. If the underlying form of the indefinite article is simply /ün/, with the masculine form derived by rule 20, this pronunciation will not be derived, since the nasalization rule simultaneously deletes the nasal consonant.

Dell 1970 accounted for such facts by separating nasalization into two parts: a rule to nasalize vowels in the context of 20, and a distinct rule to delete nasal consonants following a nasal vowel. He was thus able to relate forms such as *un enfant* to the general properties of liaison, by saying that the liaison rule (on his analysis, a rule metathesizing a final consonant with a word boundary before an initial vowel) follows nasalization—but, at least for words like *un*, precedes and bleeds nasal consonant deletion.

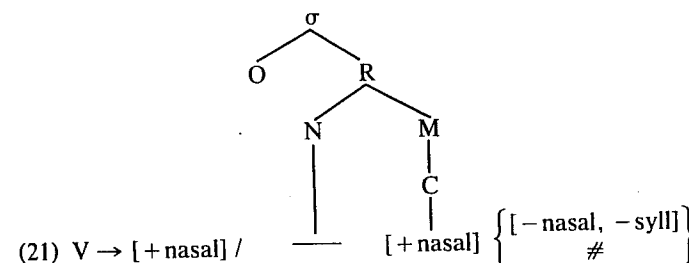
Selkirk 1972 objects to Dell's analysis on the grounds that (a) it involved a liaison rule metathesizing word boundary with a final consonant (as discussed above in §6); and (b) it required the rules of liaison and nasalization to apply in different orders for forms like *un enfant* and *bon enfant* [bɔnāfā] 'good child', in which the preservation of the nasal in liaison is associated with the FAILURE of nasalization. Her solution was to enter forms such as *un* 'a', *son* 'his/her', *mon* 'my', *bien* 'well' etc. in the lexicon with basic nasal vowels, as opposed to forms like *bon* 'good', etc. which have underlying oral vowels. Then the rule of liaison can apply uniformly to bleed nasalization (and nasal consonant deletion, which can be collapsed with it as in 20), since this rule need not apply to the liaison forms.

There is reason to believe, however, that Selkirk's analysis will not provide the best solution to the problem of how to differentiate the behavior of words like *un*, *mon* etc. (which show nasal vowels even in liaison contexts) and *bon* etc. (which show oral vowels there). This is because at least some of the words which behave like *mon*, in showing nasal vowels uniformly, display vowels which differ in significant ways from the quality of oral vowels with which they alternate. If words like *unlune*, *aucun/laucune* 'not any' (masc./fem.), *commun/commune* 'common' (masc./fem.), and *divin/divine* 'divine' (masc./fem.) are given the underlying representations /œn/, /okœn/, /kɔmœn/, and /divœn/, then we must have a rule of denasalization to derive the feminine forms [ün], [okün], [kɔmün], and [divin] (unless we treat these alternations as purely lexicalized, as does Selkirk—who does not, however, consider the full range of cases in which such quality alternations occur). The form [divin] also appears in liaison contexts in a few stock phrases (*le divin enfant* [lœdivināfā]), which would pose a similar but distinct problem for this view. This rule of denasalization exactly duplicates (in reverse) the effect of the nasalization rule, which we need in any event to derive the forms of the other class. Many of the forms which show nasal vowels in liaison have either no feminine form to show an alternation—as with *rien* 'nothing'—or a suppletive one, e.g. *mon* 'my' (masc.) vs. *ma* (fem.); but for those that do show an alternating feminine, this problem is a significant one.

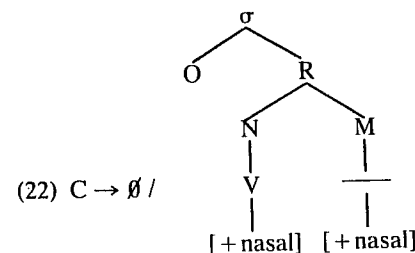
On Selkirk's analysis, the final consonant of *bon* is deleted by the rule of

nasalization. The final consonant of *mon*, however, is not subject to this rule, which applies only to underlying oral vowel plus nasal sequences. Nonetheless, this final consonant is deleted—by the general rule of final consonant truncation in non-liaison contexts. Nasal consonants are thus deleted in this environment, regardless of whether or not they are responsible for nasalizing a preceding vowel. This suggests that, indeed, nasal consonant deletion is at least partially independent of vowel nasalization.

Let us assume that alternating nasal vowels derive uniformly from sequences of oral vowel plus nasal consonant, and that the grammar does not contain complementary nasalization and denasalization processes (as in Selkirk's analysis). We then need a rule to nasalize vowels in essentially the environment of 20 above, plus a rule to delete nasals after nasal vowels, except in liaison contexts. In formulating the nasalization rule, we might be struck by the fact that a vowel plus nasal sequence which is followed by an obstruent or word boundary is necessarily tautosyllabic; but if another vowel follows, the first vowel and the nasal presumably belong to different syllables. We might, then, formulate the nasalization rule so that it explicitly refers to syllabic structure:



We now need a rule to delete a nasal consonant which follows a nasal vowel; but we want this rule to apply only in non-liaison contexts. If sequences of nasal vowel plus nasal consonant derive in general from the operation of rule 21, and if the phenomenon of liaison is correctly characterized as suggested above, then we can easily differentiate liaison from non-liaison cases in terms of syllabic structure. That is, liaison corresponds to the case in which rule 18 (the generalized enchaînement rule) transfers a final consonant into a following syllable; where this does not apply, the final consonant that produces nasality in rule 21 will continue to be tautosyllabic with the nasal vowel. Assuming that the liaison rule precedes nasal consonant deletion, then, we can formulate the latter as follows:



This rule will correctly delete nasals after nasal vowels in non-liaison contexts (where the two remain tautosyllabic), but not in liaison contexts (where the enchaînement rule removes the nasal consonant from its original syllable).

We can now return to the problem of how to differentiate the words that behave like *mon*, keeping nasal vowels in liaison, from those that behave like *bon*, showing oral vowels in liaison. If we take the *bon* class first, we see that the condition already included in rule 21 could be invoked; i.e., rule 21 requires that the vowel and the nasal consonant in question be tautosyllabic; and if we assume that liaison (or rather, enchaînement) applies to these words before nasalization, it will have the effect of bleeding the latter rule by removing the nasal from its original syllable. For the *bon* class, then, we need rules 18, 21, and 22, exactly as stated above, to account for the facts.

What of the *mon* class, then? For these forms, two accounts seem possible. One follows the lines of Dell's original analysis (1970), and assumes that the same rules apply to these forms, but in different orders. If the rules above applied in the order (a) nasalization, (b) enchaînement, (c) nasal consonant deletion, then in liaison contexts the first vowel of, e.g., /mɔ̃n#anfan/ would be correctly nasalized (since, underlyingly, it is followed by a tautosyllabic nasal). However, the subsequent application of enchaînement would prevent the rule of nasal consonant deletion from applying, and would thus yield the correct pronunciation [mɔ̃nāfā]. Forms like *mon* vs. forms like *bon* would thus be characterized in some way to undergo rules 18 and 21 in different orders. Given the fact that, in at least some circumstances, the same rules must be allowed to apply to forms of different classes in different orders (cf. Anderson 1974 and elsewhere), this may well be a viable solution; but the instances in which this difference is a lexical idiosyncrasy, rather than a consequence of some other difference in phonological structure, are few and poorly supported.

Another possibility suggests itself, however. We might note that forms such as *mon* undergo nasalization before a following nasal whenever the sequence meets the strictly segmental condition of being followed by either a non-nasal consonant or a # boundary, without regard to syllabic structure. We could propose, then, that the difference between the two classes of forms resides in the applicability of the syllable-structure condition in rule 21: forms like *bon* require it to be met, while forms like *mon* do not. A mechanism by which we could specify this difference is not hard to construct; but in the absence of further concrete instances, it does not seem worthwhile to engage in formalism for its own sake. The essential point is that, if the rules apply in the fixed order (a) enchaînement, (b) nasalization, (c) nasal consonant deletion, then we can differentiate the two classes by saying that *mon* words undergo a less constrained nasalization rule—one with only the segmental, and not also the syllabic, conditions of rule 21. Since (according to Tranel 1981 and Grevisse 1959) it appears that language change in standard French has tended to generalize the behavior of words of the *mon* class, this would appear to be an instance of a gradual change (by lexical diffusion) that consists of a rule simplification.

Various other parts of the grammar of French can also be argued to involve conditions which rest on syllabic structure, and which cannot be treated in a

descriptively adequate fashion in a framework that allows only segmental structure. The most decisive evidence which I hope to have offered for this proposition, however, is the analysis of shwa: since the underlying representation of this vowel seems to be one which is essentially syllabic (in that it has no segmental content), there seems to be no serious alternative of a purely segmental character. The coherent and comprehensive treatment of the peculiarities of this vowel which is permitted by such a syllabic treatment provides a clear and compelling argument for incorporating syllabic structure, of the sort proposed in §4 above, into phonological theory.¹⁴

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¹⁴ Another analysis of many of the facts above has been given by Selkirk 1978, in which appeal is made to a suprasegmental unit (the FOOT) which is itself composed of syllables. The essential point of her analysis is that, while most feet in French consist of exactly one syllable, a foot may also be composed of two syllables when the second one contains a shwa. Various rules are posited to group shwas into feet with preceding syllables; a single rule of deletion is then posited, applying to shwa when it is final in a complex foot. Vowels in 'closed syllables' are defined as vowels that are not final in their foot.

This analysis has the virtue of including only a single shwa-deletion rule, but it has several disadvantages with respect to the present account: (a) it does not address (or resolve) the problem of the underlying representation of shwa; (b) the notion of 'closed syllable' on which it is based is quite distant from the traditional understanding of a syllable with a non-null margin; and (c) it provides no way to unify the behavior of *h*-aspiré words, in that the facts of shwa deletion are quite separate from those of elision and truncation. In addition, the process of shwa deletion (in foot-final position) must be followed by a resyllabification of the residual consonantism of the syllable—which essentially duplicates the effects of the processes posited in my analysis. Thus Selkirk's account involves essentially the same apparatus as that given here, but with the added complication of imposing a foot structure which seems to yield no significant advantages, and which in fact obscures certain generalizations captured above. Some languages undoubtedly make some use of the unit 'foot' in their phonologies; but it does not appear to be motivated for French by the facts surrounding shwa. If the foot corresponds to a phonetically real unit of timing, it would appear realistic to suggest that in a 'syllable-timed' language (as French is sometimes asserted to be), foot structure is essentially trivial: each foot consists of one surface syllable. Some syllable-timed languages may have more complex or abstract notions of the foot, but French appears to provide no motivation for anything of the sort.

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