

Is French Optimal?*

A question concerning phonological process order

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1 Introduction

In this article, an analysis will be presented of a central part of the phonology of French in the framework of Optimality Theory (OT).

OT has three major principles that characterize and define it: (i) the idea that phonological processes are driven by their output, (ii) the idea that constraint are ranked and can be violated, and (iii) the idea that there is no genuine derivation, but just a single input-output mapping, at least within a single phonological stratum.

It will be shown that central facts in French phonology strongly suggest that the phonological processes at hand should be described as output-driven. Also, the facts suggest that violable constraints should play a central role in the language.

Therefore, that the phenomena in question seem ideally suited for an analysis in OT-terms, because of the strong need for two of the three principles mentioned above that define OT. A comprehensive OT analysis of the processes at hand will be presented. It will become clear, however, that a basic feature of the interaction of the processes collides with the third of the above mentioned defining principles of OT, i.e. the absence of derivation.

2 Two output-driven processes

In French, there are two processes affecting syllable structure that take place in a variety of contexts, viz. schwa/zero alternation and high vowel/glide alternation. These two processes seem very complicated if one tries to describe them in terms of input environments. They are much less complicated, however, if they are described in terms of output environments, i.e., if analyzed as being driven by their output. I will start off by giving a brief description of the two processes.

2.1 Schwa/zero alternation

French schwa-zero alternation is usually described as an extremely complex and variable process. The apparent complexity of the alternation is illustrated by the fact that Dell (1973, 1980, 1985), working in an SPE-framework, needs no less than ten rules (some of which are very complex) to describe the phenomenon (on top of these ten rules, an additional derivational constraint is proposed in Dell (1976, 1980, 1985)).

The alternation takes place in a variety of (input) contexts. In certain environments the deletion of schwa is obligatory, in others it is optional, and in yet other environments schwa deletion cannot place at all.

Because of the surface complexity of schwa/zero alternation, I will first present a short classification of the apparent alternation types (we will later see that they can all, except one, be reduced to a single process). In general, as pointed out by many scholars (see, e.g. Verluyten 1988: 1-4), schwa is not predictable in French. Compare the near minimal pair in (1):

- (1) a. la pelouse /la#pələuz/ [lapələuz] ~ [lapluz] ‘the lawn’
b. la place /la#plas/ [laplas] *[lapəlas] ‘the place, the square’

For this reason, schwa/zero alternation has to be generally be described as a deletion process. In all, six types of schwa/zero alternation in French are to be distinguished, five of which are deletions. The sixth type is a rather special case of schwa insertion, which I will treat in §2.1.3.

But first, in §2.1.1, I will treat three types of schwa-deletion, which for reasons that will become clear, are core types. Subsequently, in §2.1.2, I will present two more cases of schwa-deletion. These special cases are treated primarily to preempt possible counter-evidence that one might adduce against the analysis that follows. Both cases result from the fact that in French more complex clusters are allowed at word or phrase edges than word- or phrase-internally. They will both be shown to be a subcases of one of the three core types.

The final type of schwa/zero alternation to be treated is schwa-insertion. This is a very specific case, which, as will be shown, is also linked to the fact that in French more complex clusters are allowed at word or phrase edges than word- or phrase-internally.

2.1.1 Schwa-deletion: three core types

Consider the instances of the (non-) application of schwa-deletion given in (2)-(5):

- (2) *schwa in prevocalic position: deletion obligatory*
- a. l'homme /lə#ɔm/ [lɔm] *[ləɔm] 'the man, mankind'
 - b. l'ours /lə#uRS/ [luRS] *[ləuRS] 'the bear'
- (3) *schwa in postvocalic position: deletion obligatory*
- a. entendue /ãtãd+y+ə/ [ãtãdy] *[ãtãdyə] 'heard' (fem.)
 - b. jolie /ʒɔli+ə/ [ʒɔli] *[ʒɔliə] 'pretty' (fem.)
 - c. risée /Riz+e+ə/ [Rize] *[Rizeə] 'laughed at' (fem.)
- (4) *schwa in a 'two sided open syllable' (VC__CV)*
- a. tu devenais /ty#dɔvənɛ/ 'you became'
- deletion of a single schwa: optional*
- b. [tydɔvənɛ]
 - c. [tydɔvnɛ]
 - d. [tydvənɛ]
- deletion of both schwas: forbidden*
- e. *[tydvnɛ]
- (5) *schwa in more complex consonantal environments*
- a. Henri devrait partir /ãri#dɔvrɛ#partir/ [ãrid(ə)vɛ partir] 'Henri would have to leave' (*deletion optional*)
 - b. Jacques devrait partir /ʒak#dɔvrɛ#partir/ [ʒakdɔvrɛ partir] 'Jacques would have to leave' (*deletion forbidden*)

The forms in (2) and (3) show that deletion of schwa in, respectively, prevocalic and postvocalic positions is obligatory. It is noteworthy that if no deletion were to take place in these forms, they would end up with a sequence of two vowels, one of which is a schwa.

The forms in (4), display schwa deletion in a 'two sided open syllable' (VC__CV). This type of schwa-deletion seems optional, because (4a), where no schwa has been deleted, is also a possible form. The facts, however, are more complicated than that. If there are two consecutive schwas both in a VC__CV environment (i.e. VCəCəV), only one of the two schwas can be deleted. Thus, the phonetic form in (4d), *[tydvnɛ], is excluded.

To explain this, traditional descriptions of French, starting with Grammont (1914: 229), invoke a LAW OF THREE CONSONANTS, which says that schwa should be pronounced in order to avoid a sequence of three consonants. It should be noted that this LAW OF THREE CONSONANTS is in fact an output constraint: it says that the output of a process may not contain a

sequence of three consonants.

The reason behind the LAW OF THREE CONSONANTS can be understood if one considers syllable structure of French. The sequence [dvn] in *[tydvnɛ] cannot be analyzed as a sequence of syllable-final plus syllable-initial consonants: [dv] is not possible syllable-final consonant sequence (at least word-internally), nor is [vn] a possible syllable initial consonant cluster (again word-internally).¹

The necessity of an output constraint like this becomes clear, if one considers purely input-driven accounts. A purely input-driven grammar is at great pains to derive the desired output. Dell (1973, 1980, 1985: 253) proposes two fairly identical looking ordered rules, one of which is optional, the other obligatory:

(6) VCE₁ ə → Ø / V#₁C ____ (optional)

(7) VCE₂ ə → Ø / VC ____ (obligatory)

The derivations of *tu devenais* (cf. (4)) are given in (8) (Dell 1973, 1980, 1985: 233):

(8) a.	/ty#dɔvənɛ/	/ty#dɔvənɛ/	b.	/ty#dɔvənɛ/
	VCE ₁ ty#d vənɛ		VCE ₁ ty#dɔv nɛ	
	VCE ₂	ty#dɔv nɛ	VCE ₂	ty#d v nɛ
	[tydvnɛ]	[tydɔvnɛ]		*[tydvnɛ]

By ordering the nearly identical rules VCE₁ and VCE₂ Dell's analysis can derive [tydvnɛ], as well as [tydɔvnɛ], and it can account for the impossibility of *[tydvnɛ]. But it cannot account for the perfectly possible form [tydɔvənɛ]. It should also be noted that the fact that there are two nearly identical rules applying in bleeding order (i.e. if one rule applies, the other does not), makes one suspect that there is in fact only a single process, but that the conditioning of its application is slightly different across word-boundaries than word-internally.

Finally, looking at the form in (5a), one notices that deletion of schwa is possible even in a more consonantal environment than VC__CV. Here, there is an additional consonant in the onset of the third syllable (and also an intervening word boundary). If the result can be analyzed in a sequence of permissible syllable-final and syllable-initial clusters, like in (5a), *Henri devrait partir*, where [dvr] can be analyzed as a possible syllable ending, (or coda), followed by a syllable onset ([d.vR], where '.' indicates a syllable boundary), then deletion of schwa is possible.² On the other hand, the schwa in the form in (5b), *Jacques devrait partir*, cannot be deleted, because [kdvr] can-

not be analyzed into a permissible word-internal coda-onset sequence.

Classified according to their input environment and mode of application, three core types of French schwa-deletion can now be distinguished:

- (i) prevocalic schwa-deletion, obligatory;
- (ii) postvocalic schwa-deletion, obligatory;
- (iii) schwa-deletion elsewhere, which takes place optionally provided that the resulting form is syllabifiable.

2.1.2 Schwa-deletion at phrase edges

For the sake of completeness, two more specific types of schwa-deletion must be mentioned, because they seem to be distinct from the ones mentioned above. As we will see later, however, their special character results from the interaction of another phenomenon in French, i.e. the fact that more consonants are allowed phrase-initially and -finally than phrase-internally. The first type to be mentioned is schwa-deletion in phrase-initial syllables. Cf. the examples in (9).

- (9) a. revenez [RƏVəne] ~ [RVəne] demain 'come back tomorrow'
b. te fais [təfɛ] ~ [tfɛ] pas de bil 'don't worry'

This type of schwa/zero alternation can be seen as a special case of schwa-deletion in a consonantal environment. A preconsonantal schwa following an initial consonant can be deleted with the possibility of leaving an unusual onset cluster not found in other positions. The highly marked onset is, however, allowed at the beginning of a stress unit.

A similar case is schwa-deletion in phrase-final syllables. Examples of this are given in (10):

- (10) a. la terre est plate [latɛRɛplat] 'the earth is flat'
b. la route est longue [laRutɛlɔ̃g] 'the road is long'
c. je vois l'autre [ʒəvwalotR(ə)] 'I see the other'
d. voilà mon oncle [vwalamɔ̃nɔ̃kl(ə)] 'there is my uncle'

The consonants in the onset of the final syllable are attracted to the coda of the prefinal syllable, which bears stress, leaving an onsetless schwa-syllable, which is consequently deleted (similar to postvocalic schwa-deletion in (3)). This analysis is based on analyses of similar attraction processes in English (see Hoard (1971: 137-138) and Selkirk (1984: 367)).

The attraction takes always place in the case of a single onset consonant, and is optional in the case of an onset cluster. Hence the resulting deletion is

obligatory (10a,b) or optional (10c,d). The reason for the optionality of the attraction in the case of a consonant cluster lies in the complicated coda that then ensues. For further discussion on coda attraction see Noske (1993: 206-208).

2.1.3 Schwa-insertion

There is another type of schwa/zero alternation that results from the situation that arises when words with complex codas which are only allowed phrase-finally, are concatenated within a single phrase. Compare the examples in (11):

- (11) a. un contact fugitif [œkɔ̃takt(ə)fyʒitif] ‘a fleeting contact’
b. l’index boursier [lɛ̃dɛks(ə)bursjɛ] ‘the stock exchange index’
c. un film doublé [œfilm(ə)dublɛ] ‘a dubbed film’

The [kt], [ks] and [lm] clusters in *contact*, *index* and *film* respectively are not possible phrase-internal codas. For this reason, the final elements of these clusters are analyzed as onsets of following syllables, whose empty nuclei are filled by the default vowel, schwa. This insertion is undergone by loan words that have not gone through the Gallo-Romance and Old French phonological filter, but have been introduced later in the language history (in the case of (11), from Latin (*contact*, *index*) and English (*film*)).

The fact that epenthesis seems to apply optionally is not the result of an optionality of the process itself, but rather of the variability of its domain of application. During the syllabification of e.g. *un contact fugitif*, *un contact* can be taken as a phrase for syllabification, in which case no epenthesis will take place, because [kt] is a possible phrase-final coda, (as we have just seen in §2.1.2). If, in slightly faster speech or more colloquial speech, the entire sequence *un contact fugitif* is taken as a unit for syllabification, [kt] is phrase-internal. It is, however, is not a possible phrase-internal coda (nor is [tf] a possible phrase-internal onset). Therefore, epenthesis will take place in that case. Hence the variability of epenthesis in cases like these is the result of the variability of the domain of syllabification.

2.2 High vowel/glide alternation

2.2.1 Gliding

Examples of the second output-driven process, high vowel/glide alternation, are given in (12)-(14):

(12) *gliding obligatory*³

- a. Ouest /uɛst/ [wɛst] *[uɛst] ‘West’ (spoken in isolation)
b. huissier /yis+je/ [ɥisje] *[yisje] ‘usher’ (spoken in isolation)

(13) *gliding optional*

- a. nier /ni+e/ [nie] ~ [nje] ‘to deny’
b. nuage /nyaʒ/ [nyaʒ] ~ [nɥaʒ] ‘cloud’
c. l’Ouest /lə#wɛst/ [luɛst] ~ [lwɛst] ‘the West’

(14) *gliding forbidden*

- a. grief /gRiɛf/ [gRiɛf] *[gRjɛf] ‘grievance’
b. trouer /tru+e/ [true] *[trwe] ‘to punch a hole’

Just as the phenomena of schwa/zero alternation, those of high vowel/glide alternation seem to have a high degree of complexity, if one looks at them in a traditional way, i.e. as being conditioned by their input. An account was given by De Kok & Spa (1978), who, like Dell working in an SPE-framework, propose two rules, a gliding and a dieresis (i.e., change of glides into high vowels) rule. These rules are fairly complex and work into each other’s opposite directions.

Striking similarities can be found between the outputs of gliding and of schwa-deletion. If we look at the forms in (12), where gliding applies obligatorily, we see that if gliding were not to take place, the output would otherwise consist of an onsetless syllable solely containing a high vowel. This recalls the schwa-deletion in postvocalic position, examples of which were shown in (3). If in these cases schwa-deletion were not to take place, the result would be an onsetless syllable containing a schwa only.

A further similarity between the application of schwa-deletion and gliding can be observed if one looks at the examples of non-application of gliding given in (14). If gliding were to apply in these forms, their result would be a sequence an onset consisting of three consonants. This kind of sequence is disallowed in French, apart from certain *s+stop+liquid* sequences (like in *scrupule, sclérose, strict, splendide*).⁴ It is also for cases like this that Grammont stated his LAW OF THREE CONSONANTS. There appears in fact to be a close parallel to schwa-deletion, which, it is recalled, cannot take place if the resulting form cannot be divided into permissible syllable, cf. the form in (4b), *Jacques devrait partir*.

While there exists generally a free variation between a high vowel and a glide in environments like those in (13), there are forms where we only find a glide in this type of environment, cf. (15) (the examples have been taken

from Kaye & Lowenstamm (1984: 136, 142)):

- (15) a. le watt /lə#wat/ [ləwat] *[luat] ‘the watt’
 b. le week-end /lə#wikɛnd/ [ləwikɛnd] *[luikɛnd] ‘the weekend’
 c. le huit /lə#ɥit/ [ləɥit] *[lyit] ‘the eight’
 d. le yogourt /lə#jogurt/ [ləjogurt] *[liogurt] ‘the yoghurt’
 e. le western /lə#wɛstɔrn/ [ləwɛstɔrn] *[luɛstɔrn] ‘the western’

In this class of words (mostly, but not exclusively, loan words), a pronunciation is possible with a schwa in the article (in faster speech, the schwa can be elided). However, the words ALWAYS show up with a glide and never with a corresponding high vowel. Therefore, these forms must be assumed to contain an element that is different from the high/vowel glide in (13). The glides in (15) must be assumed to be underlyingly fully specified as a full consonant.

Certain verb and noun endings also must be analyzed as containing an underlying glide, because they do not alternate freely with a corresponding high vowel in the environment C_V. They are the past tense verb endings *-ions*, *-iez* (De Kok & Spa 1980), but also the noun endings *-ion*, *-ier* (Jaap Spa, p.c.). Examples are given in (16):

- (16) a. (nous) allions /al+j+ɔ̃z/ [aljɔ̃] *[aliɔ̃] ‘(we) went’
 b. (vous) alliez /al+j+ez/ [alje] *[alie] ‘(you) went’
 c. camion /kam+jɔ̃/ [kamjɔ̃] *[kamiɔ̃] ‘lorry’
 d. poirier /pwar+je/ [pwarje] *[pwarie] ‘pear tree’

2.2.2 Dieresis

It is very interesting to note that if the endings in (16) show up in an environment in which the glide cannot be properly syllabified for reasons of syllabic well-formedness, the glides turn into a high vowel, a process traditionally called DIERESIS. Examples are given in (17):

- (17) a. (nous) entrions /ãtr+j+ɔ̃z/ *[ãtrjɔ̃] [ãtriɔ̃] ‘(we) entered’
 b. (vous) entriez /ãtr+j+ez/ *[ãtrje] [ãtrie] ‘(you) entered’
 c. histrion /istr+jɔ̃/ *[istrjɔ̃] [istriɔ̃] ‘histrion, actor’
 d. ouvrier /uvr+je/ *[uvrje] [uvrie] ‘worker’

Here again, we are confronted with a phenomenon for which the LAW OF THREE CONSONANTS used to be invoked. Like in the case of words like *grief* (cf. (14)), an onset consisting of three consonants is avoided.

2.3 Synopsis of the common properties of schwa/zero alternation and high vowel/glide alternation

It can now be established that the processes of schwa-deletion and gliding seem very similar if looked upon from the structure of their output forms. There are four common properties:

- (i) Neither schwa-deletion nor gliding takes place if the resulting form were unsyllabifiable, cf. (4b), *d[ə]vrait partir* and (14a) *gr[i]ef*.
- (ii) A schwa or a high vowel loses its status as a nucleus element (by deletion or gliding) wherever this is possible and the onset or rhyme structure is not made more complex (i.e. made to contain more than one element). Examples are (1a) *l'homme*, (3a), *entendu*, and (13a), *Ouest* [wɛst] *[uɛst]).
- (iii) Otherwise there is a trade-off between the increase of syllabic complexity and decrease of the number of syllables, resulting in optionality of schwa-deletion and gliding. This can be seen in (3), *tu devenais* [tydəvənɛ] ~ [tydəvnɛ] ~ [tydvənɛ], and (13a), *nier* [nie] ~ [nje].
- (iv) Processes in the opposite directions (i.e., schwa-insertion (epenthesis) instead of -schwa-deletion and dieresis instead of gliding) take place only if there is a concatenation of elements with complex consonant sequences that cannot be syllabified properly into a single stress phrase, as exemplified by (11a), *contact[ə] pénible*, and (17a), *entr[i]ons*.

These four common properties of schwa/zero alternation and high vowel/glide alternation make us wonder if these phenomena are not conditioned in an identical way. To get a precise picture, we must investigate what the underlying shapes of schwa and high vowels are.

2.4 The underlying status of schwa and high vowels

Schwa is the neutral vowel in French. Therefore, its phonetic value needs not be specified underlyingly. Instead, schwa can be analyzed as a segment only specified for syllabicity (in certain types of representation, an empty V-slot). The default value for vowels, schwa, is automatically assigned to it during the phonetic interpretation.

The observed deletion phenomena can take place if it is assumed that in contrast to a fully specified segment, an unspecified vowel (schwa) need not be incorporated into a syllable nucleus, provided the resulting form still has a

permissible syllable structure.⁵ Schwa-insertion, on the other hand, is the result of an empty nucleus provided by syllabification (or, in OT, by GEN) which is spelled out as unspecified vowel (or, in certain types of representation, an empty V-slot) which in its turn receives its phonetic interpretation as schwa. This happens solely if this is needed to arrive at a permissible syllable structure.

High vowels behave in partially the same way. Like schwa, a high vowel need not be incorporated into a syllable nucleus, provided the resulting form has a permissible syllable structure. Unlike schwa, however, high vowels do have a prespecified phonetic content. If they are changed into a glide, this content, or feature structure, remains and only the position of the segment in the syllable changes. This freedom to change places in the syllable is explained if it is assumed that the skeletal slot to which the features of a high vowel is linked is not specified for syllabicity, i.e., if it is not specified for syllabicity (or if it is, in certain types of representation, an X-slot). This segment can be linked to a nucleus as well as to an onset node.

The lack of congruity in behaviour between high vowels in general and the specific glides in the forms in (15) (*le whisky*, etc.) and (16) (*all[j]ons*, etc.) can be accounted for by assuming that these latter forms contain a specification as a consonant, i.e. if they contain the specification [+consonantal] or, in certain types of representation, if they are linked to a C-slot, instead of to an X-slot.

3 An analysis in the optimality framework

3.1 An output-oriented analysis predating OT

Three out of the four similarities between the outputs of schwa-deletion and gliding listed in §2.3 were the inspiration of an output-based analysis that precedes OT by more than a decade, i.e. Noske (1982, 1988). In that analysis, two contextless rules are proposed, one called SCHWA-DELETION which simply deletes schwa, and the other one called SEMIVOCALIZATION (gliding) which changes the feature specification of [+syllabic] in [-syllabic] in high vowels:

(18) *Environmentless Rules* (Noske (1982: 257-258), (1988: 44))

- a. *Schwa-deletion* $\text{ə} \rightarrow \emptyset$
- b. *Semivocalization* $\begin{bmatrix} +\text{syll} \\ +\text{high} \end{bmatrix} \rightarrow [-\text{syll}]$

The application of the these two rules is subject to two conditions: one condition, the SYLLABIFICATION CONDITION, embodies the characteristic mentioned under (i) in §2.3 above: the output of the rules must be syllabifiable. The second of the two conditions, the MARKEDNESS CONDITION, refers to a notion of SYLLABIC MARKEDNESS. The syllabic markedness value of a given form is a numerical value computed from the degree of complexity of the onsets and rhymes of the form in question, as well as from the number of syllables of the form:

(19) *The Markedness Condition*

The environmentless rules MAY NOT apply if the syllabic markedness value of their output would be higher than that of their input, they CAN apply if the SYLLABIC MARKEDNESS VALUE of their output is equal to that of their input, they MUST apply if the syllabic markedness value of their output is lower than that of their input.

The SYLLABIC MARKEDNESS VALUE of a given form is also a basic principle governing syllabification and can be determined with the following scale (Noske 1982: 271, 1988: 55):

(20) *Markedness scale*

(inspired by Kaye & Lowenstamm 1981))

onset	rhyme	markedness value
C	V	0
∅	VC	1
CC	VCC	2
C ₁ ...C _n	VC ₁ ...VC _n	n

The actual computation of the syllabic markedness of a phrase takes place according to the following rule (Noske 1982: 273, 1988: 56):

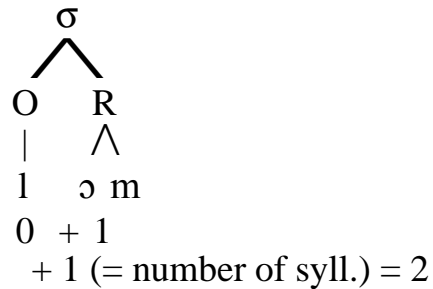
(21) *computation of the syllabic markedness value of a phrase:*

- i. determine the markedness values of all onsets and rhymes by means of the markedness scale in (20);
- ii. add the markedness values together and add value 1 to the sum of the markedness values for each syllable.

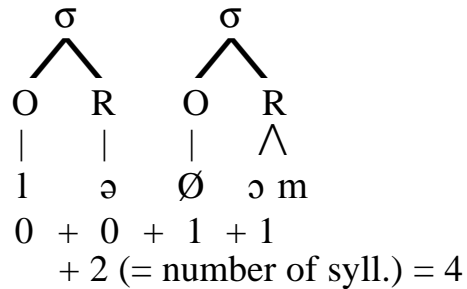
To briefly illustrate the working of the constraints, I give here the possible syllabifications of some of the forms given above. First the application of the (non-)application of SCHWA-DELETION (18a). The result of application and non-application of SCHWA-DELETION for the form in (2a), *l'homme*, is given in (22):

(22) l'homme /lə#ɔm/

a. [ləm]



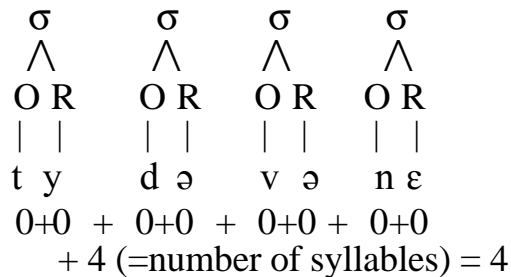
b. *[ləɔm]



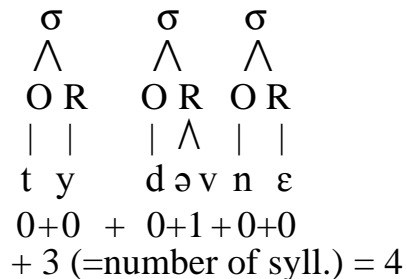
Here, SCHWA-DELETION applies obligatorily because non-application would result in a higher SYLLABIC MARKEDNESS VALUE (4 instead of 2), due to an empty onset and a higher number of syllables. Next, let us look at the form in (4), *tu devenais*:

(23) tu devenais /ty#dəvənɛ/

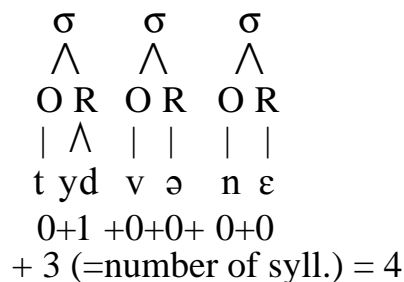
a. [tydəvənɛ]



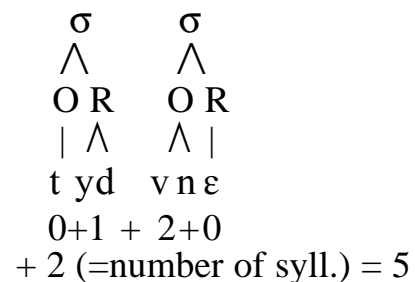
b. [tydəvnɛ]



c. [tydvənɛ]



d. *[tydvənɛ]



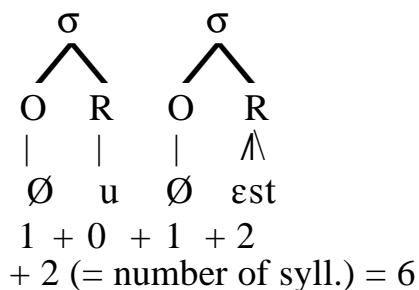
In (23) one can see that the three forms [tydəvənɛ], [tydəvnɛ] and [tydvənɛ] (resulting either from application of SCHWA-DELETION to one of the two schwas or from non-application) are equally possible because they have the same SYLLABIC MARKEDNESS VALUE, i.e. 4. The fourth form, *[tydvənɛ] (resulting from application of SCHWA-DELETION to both schwas), is not possible because its SYLLABIC MARKEDNESS VALUE is higher than that of the other forms and hence is ruled out by the MARKED-

NESS CONDITION in (19b), (the form in (23d) is also excluded by the SYLLABIFICATION CONDITION, because *vn* is not a possible word-internal onset in French; the exclusion of *[tydvne] by its higher SYLLABIC MARKEDNESS VALUE is used here only by way of illustration).

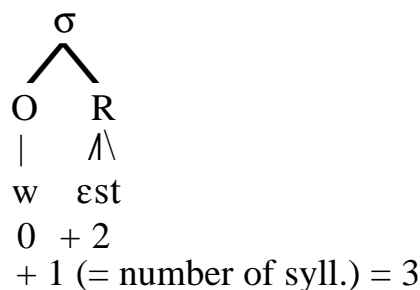
We now turn to SEMIVOCALIZATION (18b). An example of obligatory application of this process is the form already given in (12a), *Ouest*:

(24) *Ouest* /uɛst/

a. *[uɛst]



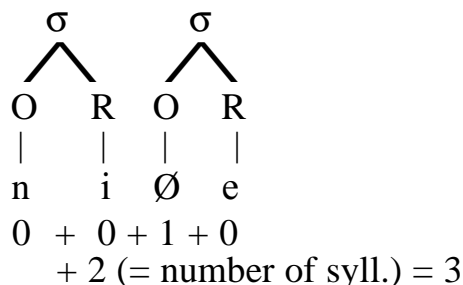
b. [wɛst]



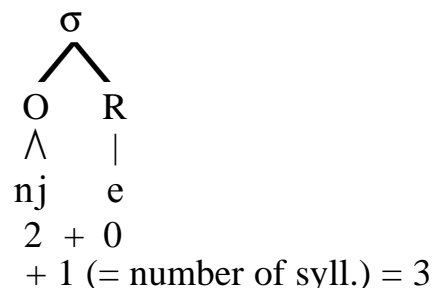
The form in (24b), where SEMIVOCALIZATION has applied, is selected as the only correct form, because it has a lower SYLLABIC MARKEDNESS VALUE than (20a), where the rule has failed to apply. In the forms in (14) SEMIVOCALIZATION applies optionally because the outcomes resulting from application and non-application result in the same SYLLABIC MARKEDNESS VALUE:

(25) *nier* /ni+e/ (= (13a))

a. [nie]



b. [nje]



Although the analysis summarized above precedes OT by more than a decade, it bears clear resemblances of this theory, because it is output-based. Given the similarity of the principles of analysis to that of OT, it is interesting to attempt a translation of the analysis in terms of OT.

3.2 Schwa-deletion and gliding in OT

Prince & Smolensky (1993: 27) mention that no counting can take place in OT, i.e. in order to decide which candidate wins, one should not have to count. There should be only a simple evaluation of constraint violation, and not an evaluation of numerical values. The highest ranked constraint of the constraints the winning candidate violates should only be lower in rank than the highest ranked constraint of the constraints violated by the outputs that should be rejected. The type of analysis outlined in the previous section does not conform to the principles of OT, because it involves the evaluation of numerical values instead of the simple evaluation of constraint violations.

Therefore, the proponents of OT have to dismiss conditions based on notions (like syllabic markedness) that are expressed by numerical means. Thereby the analysis does not comply with the principles of OT.

However, with the use of the OT principle of violable constraints, it is possible to break down the notion of SYLLABIC MARKEDNESS into two unranked constraints, whereby counting is not necessary anymore.

Two basic insights are embodied in the notion of SYLLABIC MARKEDNESS VALUE. One is that complex onsets and rhymes are preferably avoided. It is not difficult to see that this insight is the same as the one that is reflected in the well-established OT constraints NO-COMPLEX-ONSET and NO-COMPLEX-RHYME (or NO-CODA), which say that complex onsets and rhymes are disallowed. Because of the similarity of these constraints, and because they do not have to be ranked here with respect to each other, I fuse them into a single constraint NO-COMPLEX-ONSET/RHYME.

The other basic insight is that forms with less syllables are preferred, which is reflected by the fact that for the computation of the SYLLABIC MARKEDNESS VALUE of a given form, the number of syllables must be added to the markedness values of the onsets and rhymes. This insight is in the same as the one behind the constraint MONOSYLLABICITY, proposed by Golston (1995). This constraint says that forms should be monosyllabic.

Both constraints, NO-COMPLEX-ONSET/RHYME and MONOSYLLABICITY, will play a role in the attempted analysis in the OT-framework. Because, as we have seen in the possible realizations in (4) *tu devenais* and (13a) *nier*, the tendencies to avoid complex onsets and rhymes and to reduce the number of syllables in a given form seem to counterbalance each other, it must be assumed that NO-COMPLEX-ONSET/RHYME and MONOSYLLABICITY are not ranked with respect to each other.⁶


Still one constraint must be mentioned: PARSE-SEGMENT. This constraint is undominated and says that a segment must be parsed. For French, the specific assumption must be made that this constraint is not valid for empty

V-slots. This means that schwa may, but need not, be parsed into a syllable. This latter assumption reflects the contextless rule of SCHWA-DELETION (18a).

In the underlying forms in the tableaux that are to follow, a bold upper case **V** indicates a unspecified vowel (i.e. a segment whose only specification is [+syllabic], or a V-slot) which can, but need not be syllabified. If it is syllabified, it is spelled out as [ə]). Uppercase U,I,Y indicate the underlying high vowels of French. They have been capitalized in order to indicate that they are not specified for syllabicity.

Let us now look at a case which shows how the obligatory deletion of schwa in (1a)/(22), *l'homme*, can be expressed in the OT framework (‘.’ indicates a syllable boundary):


(26)

/lV#om/	PARSE-SEGMENT	NO-COMPLEX-ONSET/RHYME	MONO-SYLLABICITY
.lə.ɔm.		*	*!
 .lɔm.		*	

One sees that [lɔm] has been selected as the correct form because in the competing form, *[ləɔm], the pair of unranked constraints NO-COMPLEX-ONSET/RHYME and MONOSYLLABICITY has been violated twice, whereas in [lɔm] they have been violated only once.

The obligatory application of gliding like in the form in (12a)/(24) *Ouest* is illustrated by the following tableau:

(27)

/Uɛst/	PARSE-SEGMENT	NO-COMPLEX-ONSET/RHYME	MONO-SYLLABICITY
.u.ɛst.		*	*!
 .wɛst.		*	

Here, [wɛst] is more harmonious than *[uɛst], because the latter realization of the form contains two syllables, and hence MONOSYLLABICITY is violated.

Let us now look at optional application of schwa-deletion and gliding. Taking the more simple example of gliding first, let us consider the form in (13a)/(25), *nier*:

(28)

/nI+e/	PARSE-SEGMENT	NO-COMPLEX-ONSET/RHYME	MONO-SYLLABICITY
☞ .ni.e.			*
☞ .nje.		*	

Both realizations are equally harmonious, because either outcome violates the same number (one) of the unranked constraints NO-COMPLEX-ONSET/RHYME and MONOSYLLABICITY. The first form violates MONOSYLLABICITY because it contains two syllables, while the second form violates NO-COMPLEX-ONSET/RHYME because it contains a complex onset.

Next, we come to optional schwa-deletion. For this, we take a look at the tableau for the form in (4)/(23), *tu devenais*. As we have seen there are three possible outcomes (realization of both underlying schwas or deletion of either one of them) and an impossible outcome (deletion of both schwas). As mentioned, this latter outcome, *[tydvne], is excluded because the result is unsyllabifiable (this is handled by the SYLLABIFICATION CONDITION in Noske (1982, 1988)): [vn] is not a possible word-internal French onset and neither is [dv] a possible word-internal coda. Translated into OT terms this means that, because there are non-schwa segments (i.e. either *v* or *n*) that cannot be parsed, the undominated constraint PARSE-SEGMENT is violated. What we would like to know is why the other three forms are all possible. Here too, the unranked constraints NO-COMPLEX-ONSET/RHYME and MONOSYLLABICITY do their work as they should:

(29)

/ty#dV+vVn+ε/	PARSE-SEGMENT	NO-COMPLEX-ONSET/RHYME	MONO-SYLLABICITY
☞ .ty.də.və.nε.			***
☞ .ty.dəv.nε.		*	**
☞ .tyd.və.nε.		*	**
.tyd.v<n>ε.	*!	*	*
.tyd.<v>nε.	*!	*	*
.ty<d>v.nε.	*!	*	*

Finally, we come to cases where there can be no schwa-deletion or gliding. I can be very brief here. As already pointed out above, deletion of schwa in (5b), *Jacques d[ə]vrait partir* and gliding of *i* in (14a) *gr[i]ef* would result in unsyllabifiable consonant sequences, hence in violations of the undominated constraint PARSE-SEGMENT. Therefore the forms without schwa or with a glide are ruled out.

It has thus been shown that the non-violable MARKEDNESS CONDITION together with the notion of SYLLABIC MARKEDNESS in Noske (1982, 1988) can be replaced by two violable constraints. Therefore, OT seems to be able to express successfully the generalizations given in §2.3. There is, however, a problem connected to this analysis, which I will treat in §3.5. But first, I will show that epenthesis and dieresis can be handled successfully in OT.

3.3 The opposite processes: epenthesis and dieresis

I now come to the cases of epenthesis and dieresis. Recall from §2.3 that these processes take place only if the outcome is otherwise unsyllabifiable. Cf. the forms in (11) and (17), repeated here as (30) and (31):

- (30) a. un contact fugitif [œkɔ̃takt(ə)fyʒitif] ‘a fleeting contact’
 b. l’index boursier [lɛ̃dɛks(ə)buʁsjɛ] ‘the stock exchange index’
 c. un film doublé [œfilm(ə)dublɛ] ‘a dubbed film’
- (31) a. (nous) entrions /ãtr+j+õz/ *[ãtrjõ] [ãtriõ] ‘(we) entered’
 b. (vous) entriez /ãtr+j+ez/ *[ãtrje] [ãtrie] ‘(you) entered’
 c. histrion /istr+jõ/ *[istrjõ] [istriõ] ‘histrion, actor’
 d. ouvrier /uvr+je/ *[uvrje] [uvrie] ‘worker’

Let us first consider epenthesis. Recall that the consonant sequences [kt], [ks] and [lm] are not possible word-internal codas in French. This means that if nothing happens to the form, PARSE-SEGMENT will be violated. If, however, an empty nucleus is inserted and filled with the neutral vowel schwa, the PARSE-SEGMENT will not be violated. What will happen is that the constraint FILL, which forbids the filling of an empty subsyllabic node is violated. FILL is to be ranked under PARSE-SEGMENT, cf. the tableau for (30c):

(32)

/film+dubl+e/	PARSE-SEGMENT	FILL	NO-COMPLEX-ONSET/RHYME	MONO-SYLLABICITY
.fi<l>m.du.ble.	*!		**	**
.fil.<m>.du.ble.	*!		**	**
.fil.m<d>u.ble.	*!		**	**
☞.fil.mə.du.ble.		*	**	***

For dieresis, a slightly different analysis must be made. Recall that a glide in forms like (16) and (17)/(31) is fully specified for syllabicity, i.e. in contrast to

a high vowel it is [-syllabic]. What we need is another faithfulness constraint, a constraint that sets a penalty on the partial parsing of segments.

I will call this constraint PARSE-FEATURE. The constraint will be ranked under PARSE-SEGMENT. Cf. the tableaux in (33) and (34), which show why in forms like (16) *camion*, etc. *j* cannot change into *i*, but why in cases like (17)/(31) *entrions*, *ouvrier*, etc. the glide does change into a high vowel.

(33)

/kam+jõ/	PARSE-SEGMENT	FILL	PARSE-FEATURE	NO-COMPLEX-ONSET/RHYME	MONOSYLLABICITY
☞ .ka.mjõ.				*	*
.ka.miõ.			*!		**

(34)

/ãtR+jõz/	PARSE-SEGMENT	FILL	PARSE-FEATURE	NO-COMPLEX-ONSET/RHYME	MONOSYLLABICITY
.ã.<t>Rjõ.	*!			*	*
.ã.t<R>jõ.	*!			*	*
.ã.tR<j>õ.	*!			*	*
☞ .ã.tR.i.õ.			*	*	**
.ã.təR.jõ.		*!		*	**

3.4 The ranking of the constraints

Until now, I have not explicitly discussed the ranking of the constraints. It should be:

PARSE-SEGMENT >> FILL >> {PARSE-FEATURE, NO-COMPLEX-ONSET/RHYME, MONOSYLLABICITY}

The motivation for the ordering is as follows.

- (i) PARSE-SEGMENT is ranked higher than FILL, because otherwise there would be no insertion in (32).
- (ii) FILL should be ranked higher than PARSE-FEATURE, because otherwise the form in (33) would end up with an epenthetic schwa instead of a high vowel.
- (iii) PARSE-SEGMENT is ranked higher than NO-COMPLEX-ONSET/RHYME, because otherwise there would not be any complex onsets or rhymes (one segment in a cluster would simply not be parsed).
- (iv) FILL should be ranked higher than NO-COMPLEX-ONSET/RHYME

because otherwise complex onsets would always be split up and there would no near minimal pairs as in (1) (*place/pelouse*).

- (v) NO-COMPLEX-ONSET/RHYME should not be ranked with to MONOSYLLABICITY, because there is a trade-off between the effects of these constraints, cf. (28) (*nier* [nie]~[nje]).
- (vi) PARSE-FEATURE need not be ranked, as far as I can see, with respect to {NO-COMPLEX-ONSET/RHYME, MONOSYLLABICITY}.

3.5 Process order: problems for OT

Elegant as this OT-analysis may seem, it runs into difficulties. The problem is connected to the principle that no derivation should exist in OT. As a result there can be no process order. However, as we will see, the analysis just presented of French schwa-deletion and gliding, needs the explicit ordering of processes. For this, let us look at the interaction of these processes. Let us consider again the examples in (12)/(24), and let us put a definite article in front of them:

- (35) a. l'Ouest /lə#uɛst/ [luɛst] ~ [lwɛst] *[ləwɛst] *[ləuɛst] 'the West'
- b. l'huissier lə#yis+je/ [lyisje] ~ [lɥisje] *[ləɥisje] *[ləyisje] 'the usher'

The OT analysis wrongly predicts that *[ləwɛst] and *[ləɥisje] should be possible realizations. To see this, let us draw the tableau for (35a).

(36)

/lV#Uɛst/	PARSE-SEGMENT	NO-COMPLEX-ONSET/RHYME	MONOSYLLABICITY
.lə.u.ɛst.		*	**!
☞ .lu.ɛst.			*
☞ .lwɛst.		*	
✗ .lə.wɛst.			*

As one can see, *[ləuɛst] is excluded as it should be. However, the overall wrong prediction here is that *[ləwɛst] should be one of the correct forms, which it definitely is not (the wrong prediction is indicated by 'X').

These facts seem to create problems for the OT framework. In Noske (1982, 1988) *[ləwɛst] is excluded because the rule of SCHWA-DELETION is ordered before SEMIVOCALIZATION, In OT, however, this solution cannot be adopted, as there is no derivation.

Three types of solution could be envisaged, but unfortunately they are all three of no avail. At first sight, one might think that the data can be explained by assuming that the two processes apply at a different stratum. However, as it turns out, both processes are fully regular and there is no reason to assume that they are not postlexical. If one of the two processes were lexical, it would be gliding, as its (input or output) environment can be determined at the word level. The environment in which there is schwa-deletion is determined across word boundaries, so that process must be postlexical. Hence, if we were to assume that the two processes were to take place, gliding would take place before schwa-deletion. This would mean that we would end up with the wrong order.

Another type of solution would be to have the ‘high vowel’ *U* (which, as we have seen in §2.4, is not specified for syllabicity) fuse automatically with the *V* (which contains only the feature specification [+syllabic]), hence creating the underlying form [luɛst]. This fusion should be obligatory, for otherwise the undesired *[ləwɛst] would still be a possible outcome. However, if fusion is indeed automatic, there would be with a fully specified high vowel, and the possible outcome [lwɛst] could not be produced anymore. Again, the obvious solution is the ordering of the processes, but this option is not available in OT.

A third strategy would involve the positing of additional constraints against the realization of schwa. This type of solution, however, would inevitably put into jeopardy the free trade-off relation between the increase of syllabic complexity and decrease of the number of syllables, resulting in optionality of schwa-deletion (like in (4a), *tu devenais* [tydəvənɛ] ~ [tydəvnɛ] ~ [tydvənɛ] and gliding (as in (13a), *nier* [nie] ~ [nje]). Because this free trade-off relationship exists in both types of alternation, the heart of the analysis would be destroyed.

4 Conclusion

In this paper, the alternations between schwa and zero and high vowels and glides in French have been considered. It has been shown that the two processes are output-driven, and that they are conditioned in a strikingly similar way. Therefore, it seems that these phenomena are particularly suited to be analyzed in an OT-framework. For this reason, an OT analysis of both processes has been presented. This analysis seems at least as elegant as the pre-dating output-based analysis which was based on the reduction of syllabic markedness. The added advantage is that the present analysis can also account for the specific epenthesis and dieresis processes, which was not possible in the markedness-based analysis.

A major problem, however, is the fact that the OT-analysis cannot account for the precedence of schwa-deletion over gliding. Therefore, it seems that the processes have to be crucially ordered with respect to each other. This is at variance with the principle that, at least within a single stratum, there is only a single input-output mapping.

The problem that one encounters in the above presented analysis concerning the principle of non-derivation does not stand on its own. Many analyses of complex facts in languages demonstrate the necessity of the concept of derivation. Hence, it may be not surprising that of all the principles of OT, the principle that been most attacked is precisely the absence of derivation.⁷ In addition to this, change in rule order has proved an extremely insightful explanatory tool in historical phonology.

Therefore, one should, in my opinion, reconsider the role of derivation.

NOTES

* I wish to thank an anonymous reviewer.

- [1] The LAW OF THREE CONSONANTS has been reported to have many exceptions (see Spa (1988) for an interesting discussion). The major reason for this is that syllable structure was not taken into consideration by Grammont and his followers. However, it does indicate that output constraints should play a role in the description of schwa/zero alternation in French.
- [2] This case is one of the exceptions to the LAW OF THREE CONSONANTS observed by many scholars (see note 1).
- [3] The reason why I assume that forms like *Ouest* contain a high vowel underlyingly and not a glide lies in the fact that this high vowel comes to the surface in other contexts than if the form is spoken in isolation. Also, there are forms with an initial glide that never turns into a high vowel. Therefore, it is necessary to distinguish between underlying high vowels and underlying glides in French. The underlying status of high vowels in French will be treated in §2.4.
- [4] As counter-examples one might mention the [grw], [trw], etc., sequences one finds in words like *groin* [grwɛ̃] ‘muzzle’ and *trois* [trwa] ‘three’. The phonetic glide-vowel sequences found in these words are phonemic diphthongs, and never alternate with high vowel sequences. For more discussion on this matter, see Noske (1982: 261-263), (1988: 48-50).
- [5] The reader may ask why an underlying schwa is not simply represented as a prespecified empty nucleus. Syllabification is however, a structure

building and not a structure changing device. This entails that it would always have to incorporate a prespecified empty nucleus and spell it out as a schwa. Deletion of schwa as in (1a) *l'homme*, e.g. /lə#ɔm/, would could then not be seen anymore as directly related to syllabification.

- [6] The tendency to avoid complex rhymes (or codas) can also be expressed, instead of by a fusion between NO-COMPLEX-RHYME (or NO-CODA) and NO-COMPLEX-ONSET, by a constraint MONOMORAICITY. This constraint would require a prosodic word to be monomoraic. As one can easily see, the effects of this constraint would combine those of NO-COMPLEX-RHYME (or NO-CODA) and MONOSYLLABICITY.
- [7] Recently, in October 1995, an entire conference was held on this subject, viz. the Tilburg Conference on the Derivational Residue in Phonology.

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