Markedness, Faithfulness, Vowel Quality and Syllable Structure in French[1]

Caroline Féry

The quality of vowels in French depends to a large extent on the kind of syllables they are in. Tense vowels are often in open syllables and lax vowels in closed ones. This generalization, which has been called *loi de position* in the literature, is often overridden by special vowel-consonant coocurrence restrictions obscuring the generalization. The paper shows first that the admission of semi-syllables in the phonology of French explains a large number of counterexamples. Many final closing consonants on the phonetic representation can be understood as onsets of following rhymeless syllables, opening in this way the last full syllable. Arguments coming from phonotactic regularities support this analysis. The second insight of the paper is that the Optimality Theory is a good framework to account for the intricate data bearing on the relationship between vowels and syllable structure. The *loi de position* is an effect dubbed Emergence of the Unmarked, instantiated only in case no higher-ranking constraint renders it inactive.

1. Introduction

The goal of this paper is twofold: first to review the distributional properties of tense and lax mid vowels in French, and second, on the basis of these data, to examine the interaction between markedness and faithfulness constraints in Optimality Theory (OT, Prince & Smolensky 1993). The intricate interplay between vowel quality, syllable structure and cooccurrence restrictions between vowels and consonants that one observes

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in French makes it an ideal language for exploring the interactions between the two kinds of constraints.

As a general tendency, it can safely be assumed that tense vowels appear in open syllables and lax vowels in closed syllables; thus, that generalization (1) which has repeatedly been observed for the Germanic languages holds in French, too (see van der Hulst 1984 and Kager 1989 for Dutch, Moulton 1962, Wiese 1996 and Féry 1997 for German, Hammond 1997 for English).

(1)   Tense vowels appear in open syllables and lax vowels in closed syllables.

This tendency has been called *loi de position* in the literature on French, and has been considered mainly as an incomplete historical process. Its synchronic meaning is often denied as a consequence of the numerous exceptions to (1) (see Morin 1986 and Dominicy 2000 for instance). One complication comes from the fact that, in most dialects, only mid vowels contrast a tense and a lax variant and that the distinction is made (nearly) exclusively in the phrase-final syllable, also preconsonantally. Further complications arise because of the effect of idiosyncratic cooccurrence restrictions that override (1). Some of these difficulties are solved by a phonologically abstract model of the syllable structure. In the analysis developed below, it is assumed that French has semisyllables, confined to the word-final position, which function as onsets of nucleusless syllables. This explains why tense vowels can be in apparently (i.e. phonetically) closed syllables.

As for the second goal, this paper illustrates that roughly three types of constraints interact in grammar. First, there are markedness constraints of a general type dealing with universal tendencies. Constraints like ONSET, NOCODA, NOVOICED OBSTRUENT and the like are of this type. We will see that the constraints which work together to allow the structures in (1) to surface are of this type. Second, more specific markedness constraints, expressing particular effects like cooccurrence restrictions between vowels and consonants, are present in the grammar, as well. Finally, in the case at hand, some occurrences of lax, tense and long vowels are best understood as arising as a consequence of faithfulness to properties specified in the input. Constraints are organized in the following way: the more specific the constraints are, the higher ranking they need to be. In the absence of activity of the specific constraints, fulfillment of the general constraints lead to "emergence of the unmarked". Generalization (1) is a tendency, which is falsified in numerous examples. The elegance of OT is that it accounts for such a situation. Constraints are universal, but can be low-ranking in specific languages. Nevertheless, they are expected to play a role when no higher ranking constraint interferes. The *loi de position* is a typical case of emergence of the unmarked, since it is often obscured by exceptions but nevertheless active in the phonology.

The paper is organized as follows. The first section gives an overview of the French segments and of the data involving the mid vowels. The second section introduces the syllable structure of French. The last sections concentrate on the tense/lax alternation in the mid vowels and show how OT can deal with them.

2.   The French segments

The variety of French studied in this paper is the one of educated francophones of Brussels, a dialect of French which presents most segmental properties of Parisian French, except for the presence of the nasal vowel [œ̃], which has disappeared in the Parisian dialect, and for the preservation of lexical length contrasts, which is the topic of section 4. This dialect is called 'français standard de Bruxelles' by Dominicy (2000).[2] The most conspicuous differences between the Brussels and the Paris dialects are found in the intonation pattern and in the lexicon, which are not considered here.

2.1   Segment inventory

The inventory of French segments is given in (2) for consonants, and in (3) for vowels (see Fouché 1959, Léon 1972, Meisenburg & Selig 1998, Plénat 1987, Tranel 1987, 1995 and many others for identical or slightly different proposals).

   As for the vowels, it is well known that French contrasts more of them than most languages. In the dialect described here, the mid vowels each have a tense and a lax variant, thus [e/ɛ], [o/ɔ], and [ø/œ], while no other vowel has two phonemic variants. It thus differs from Quebec French in which high vowels also contrast for tenseness. One of the puzzles of French is why the alternation between tense and lax (or closed and open) variants of the vowels is limited to the mid ones in so many varieties. A relatively safe hypothesis is that the contrast is perceptually most salient for the mid vowels, and less clear for the other vowels.[3]

   French also has underlying nasal vowels, as in the words *cinq* 'five', *honte* 'shame' and *banque* 'bank', though most occurrences of these nasal vowels alternate with a sequence of an oral vowel plus nasal consonant. Most speakers of French have just three nasal vowels, [ɛ̃], [ɔ̃] and [ã], but some still have a fourth one, [œ̃], which has nearly disappeared in the standard language. According to Dominicy (2000), young adults from Brussels do not distinguish [ɛ̃] and [œ̃] anymore, though older adults certainly still do.

(2)   Inventory of French consonants

	Labial	Alveolar	Alveopalatal	Palatal	Velar	Uvular
Plosives (voiceless)	p	t			k	

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[2]   The only difference between Dominicy's idiolect and mine lies in the presence (for Dominicy) vs. absence (for me) of nasalization in mid vowels before nasal codas, as in *reine* 'queen', *aime* 'loves.' In all other aspects, I agree with his description.

[3]   As observed by a reviewer, a possibly more standard analysis of the distinction between pairs of vowels uses height as the contrasting feature. I prefer to use tense/lax here, since it reflects the fact that in each case the same opposition is at play. Height is also specified for vowels which do not contrast in the relevant way, like the high and the low ones.

Plosives (voiced)	b	d			g	
Fricatives (voiceless)	f	s	ʃ			χ
Fricatives (voiced)	v	z	ʒ			ʁ
Nasals	m	n		ɲ	ŋ	
Liquids		l				ʀ
Glides	w, ɥ			j		

(3)   The vocalic space in French

  i y   u

   e ø   o

              ə

   ɛ ɛ̃   œ œ̃   ɔ ɔ̃

        a ã   ɑ

Most speakers just have one oral [a]. However, in some dialects of French, though not the one considered here, a lexical distinction between two *a*-sounds still exists, especially in word-final position (see Delattre 1957, Meisenburg & Selig 1998). Some words with [a] and some with [ɑ] are listed in (4) (from Léon 1972). In the Brussels dialect, the distinction between the words in (4a) and (4b) is rendered by length (see section 4).

(4)   a. [a]: patte 'leg', gazon 'lawn', rat 'rat', tache 'stain'
     b. [ɑ]: pâte 'dough', bâtir 'to build', bâton 'stock', tâche 'task'

Schwa in French has a complex pattern of realization vs. non-realization, but it is beyond the scope of this paper to give an account of this pattern. The interested reader is referred to Anderson (1982), Basbøll (1978), Charette (1991), Morin (1987, 1988), Noske (1984), van Oostendorp (1999) and Rialland (1986, 1999), among others.

1.2   The alternation o ~ ɔ (mid back rounded vowels)

This section and the two following ones describe the contexts in which the tense and the lax variants of the mid vowels appear in the variety of French under consideration. Only

the "stressed syllables", i.e. the final syllables, are considered here, since nonfinal syllables often present idiosyncratic variation or neutralization. We will consider the alternations between [ɔ] and [o], [œ] and [ø], and [ɛ] and [e] in turn. A puzzling fact is the difference between the contexts in which the lax and the tense versions of the mid vowels appear. While the tendency expressed in (1) is clearly visible for each pair of vowels, the details of the occurrence of the individual vowels differ in the three cases. The variation of the relevant environments has led some authors to dismiss entirely the *loi de position*, as for instance Valdman (1978), Morin (1986) and Dominicy (2000). Morin argues for a contrast based on the vowel duration distinction: tense vowels are longer than lax ones. His point of view is motivated by the phonetic correlation between vowel length and syllable structure, which has been shown to be of an articulatory nature. Assuming that syllables tend to be of constant duration, the vowel of an open syllable is as long as the vowel plus consonant of a closed syllable. Short vowels followed by a closing consonant are not only shortened but also opened (Fujimura & Miller 1979). According to Morin, many of the synchronic exceptions are a consequence of the historical vowel length distinction, now largely lost in the standard language. However, in view of most of the regular data, it is not clear whether it is length or quality that should be considered as an immediate consequence of syllable structure with the other property derived. It will be shown below that OT allows us to treat length, moraic structure and quality as interdependent of each other, thus avoiding the choice of one of the properties as obligatorily primary in all cases.

Consider first the nonalternating environments for [o] in (5). The lax variant [ɔ] is not allowed in a Phonological Phrase final position, which is usually assumed to be the stressed position in French (see, however, Féry 2001 for a different analysis).[4] In this position only the tense variant [o] is possible.[5]

(5) No [ɔ] in open final syllables, but only [o]:
      boulot 'job', rideau 'curtain', seau 'bucket', sot 'silly'

Some stems have alternating o-sounds, depending on whether the vowel is in a closed or an open syllable. If the vowel is word final, it is tense, but if it is in a closed syllable, it is lax (see (6)).

(6) Alternations [o] ~ [ɔ]
      sot ~ sotte 'silly, masc., fem.'   idiot ~ idiote 'idiotic, masc., fem.'
      rigolo ~ rigolote 'funny, masc., fem.'   boulot 'work, N'~ boulotte 'works, infl. V'
      culot 'cheek' ~ culotte 'pants'   gigot 'leg' ~ gigotte 'wriggles, infl. V'

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[4]   It may occur in a hiatus position, as in *boa, Noé* 'Noah'*, Noël* 'Christmas'*, Boétie* 'name'*, oasis,* and *coopératif*, but this is not the final or "stressed" syllable of the word. In unstressed positions, many realizations are neutralized and can be either lax or tense, or have an in-between quality.

[5]   There are Belgian dialects which allow a final [ɔ] in *sot* or *auto*, a realization which is replaced by a contrast in length in the dialect described in the present paper: [o] in *sot* is shorter than [o] in *seau* (see below).

Some final consonants influence the quality of the preceding vowel, as in the examples in (7). Before [z], only [o] is found, but before [ʁ], [g], [ɲ] and [ŋ], the class of voiced dorsal consonants, only the lax variant [ɔ] is possible (see also Léon 1972).

(7)   No alternations
       a. [o] before [z]
          [z]: cause 'cause', chose 'thing', ose 'dares', rose 'rose', dose 'dosis'

       b. [ɔ] before [ʁ],[6] [g], [ɲ] and [ŋ]
          [ʁ]: corp 'body', dort 'sleeps', or 'gold', corde 'rope', forme 'form'
          [g]: vogue 'mode', pirogue 'pirogue', analogue, grog, dogue 'mastiff'
          [ɲ]: cigogne 'stork', cogne 'knocks', grogne 'moans', rogne 'bad temper'
          [ŋ]: gong, King Kong

In the remaining contexts, both variants of the mid back vowel are possible. We are confronted here with lexical variation.[7]

(8)   Lexical contrasts

[ɔ]	[o]	[ɔ]	[o]
sotte 'silly, fem.'	saute 'jumps'	roc 'rock'	rauque 'hoarse'
bosse 'hump'	Beauce 'a place name'	poche 'pocket'	gauche 'left'
love 'coils'	sauve 'saves'	loge 'is quartered'	auge 'trough'
bonne 'good'	Beaune 'a place name'	pomme 'apple'	paume 'palm'
sole 'sole'	saule 'willow'		

The distribution of the lax and the tense variants of the mid back rounded vowels is summed up in (9).

(9)   Generalizations

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[6]   In Parisian French, there is one word with [o] before [ʁ]: *Maure* 'Mauresque', minimally contrasting with *mort* 'dead'. In the Brussels dialect, however, *Maure* is homophonous with *mort*.

[7]   In unstressed syllables, the quality of the vowel depends to some extent on the quality of the stem vowel, as in (i) and (ii). In other cases, it depends on the kind of syllable it is in. If the syllable is open, it is tense (iii), otherwise it is lax (iv). It seems that the orthography plays an important role in the pronunciation of the o-sound: <ô>, <au> and <eau>, for instance, are mostly pronounced as [o].
       (i)   [o]: beau 'handsome'/beauté 'beauty', haut 'high'/hauteur 'height',
              faux 'wrong'/fauteur 'troublemaker'
       (ii) [ɔ]: botte 'boot'/botté 'in boots', sotte 'silly'/sottise 'silliness',
              bosse 'hump'/bossu 'hunchbacked', note 'note'/noté 'noted'
       (iii) [o]: auto 'car', aussi 'also', sauvé 'saved'
       (iv) [ɔ]: sortir 'to go out', colmater 'to fill in'

a. Only [o] in an open syllable. Preferably [ɔ] in a closed syllable, see (5) and (6).

b. Only the tense back mid vowel [o] before [z], see (7a).

c. Only the lax back mid vowel [ɔ] before voiced dorsal consonants, see (7b).

d. Otherwise, in word-final position before a consonant, both variants are allowed, see (8).

1.3   The alternation ø ~ œ (mid front rounded vowels)

The alternation between the mid front rounded vowels is conditioned in part by factors different from those just demonstrated for the back mid vowels. The first observation, however, agrees with what has been observed for the o-sounds. Word-finally, only the tense variant is allowed.

(10) No [œ] in open final syllables, but only [ø]:
peu 'few', feu 'fire', queue 'tail', creux 'hollow', ceux 'those', nœud 'knot', heureux 'happy'

There is also an alternation between the two variants in closed and open syllables, though the contexts are more limited than for the o-sounds. Some of them are shown in (11).

(11) Alternations [ø] ~ [œ]

peureux [ø] 'fearful'~ peur [œ] 'fear'
heureux [ø] 'happy' ~ bonheur [œ] 'happiness'
veut [ø] 'wants, 3rd pers. sg.' ~ veulent [œ] 'want, 3rd pers. pl.'

The main difference between the two alternations involves the environments in which only one of the variants is allowed. The correct generalization seems to be the following: Before a coronal obstruent, only [ø] is allowed (12). Otherwise, [œ] is generally found (13), though [ø] is also marginally tolerated.

(12) Only [ø] is allowed before a coronal obstruent

before [t]: émeute 'riot', feutre 'felt', thérapeute 'therapist', meute 'pack'
before [z]: creuse 'hollow, fem.', gueuse 'lass', heureuse 'happy, fem.', danseuse 'dancer, fem.'
before [ʒ]: Maubeuge 'a place name'
before [d]: Eudes 'a first name'

(13) Only [œ] before other consonants

before [ʀ]: heure 'hour', beurre 'butter', sœur 'sister', bonheur 'happiness'

before [j]: feuille 'leaf', cueille 'picks', œil 'eye'
before [f]: œuf 'egg', bœuf 'ox', veuf 'widow', neuf 'new'
before [v]: veuve 'widow, fem.', neuve 'new, fem.'
before [p]: peuple 'folk'
before [b]: meuble 'furniture'

Some marginal alternation contexts appear in (14), showing that [ø] can also appear before consonants other than a coronal obstruent. One member of each pair is not part of the inventory of the author (and of most other native speakers consulted) and is therefore in parentheses. In these idiolects, the contrast is neutralized to the variant not in parentheses.[8]

(14)   ø   œ
   (veule 'of a weak character')   veulent 'want, subj.'
   meule 'mill'   (meule 'stack')
   (jeûne 'fast')   jeune 'young'
   meugle 'moos, infl. V'   aveugle 'blind'

In some loanwords [œ] replaces the English vowel [ʌ], which is not part of the French vowel inventory. The sequence [œt] is perceived as foreign.

(15) [œ] in loanwords: club, hold-up, cut, trust

Moreover, there is no difference between the quality of [œ] and schwa, even if speakers of French have clear intuitions about them, mostly as a consequence of the orthography and the distributional facts. Schwa is usually written <e>, whereas [œ] is written <eu> or <œu>. And of course, schwa can be deleted but [œ] cannot.

   Leaving schwa and the vowel replacing [ʌ] in loanwords aside, the generalizations that emerge for the distribution of the mid front rounded vowels are the following.

(16) Generalizations

   a. Only [ø] in a final open syllable. Preferably [œ] in a closed syllable, see (10) and (11).
   b. Before a coronal obstruent, only [ø] is allowed, see (12).
   c. Otherwise, in word-final position before a consonant, nearly only [œ], though some rare lexical pairs still exist, see (13) and (14).

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[8]   A reviewer also mentions *Polyeucte, Pentateuque* with [ø], which are borrowings from Greek. Another reviewer mentions *foehn* 'a kind of wind' which is borrowed from German.

1.4   The alternation e ~ ɛ (mid front unrounded vowels)

Front unrounded vowels are different again. Of the three alternations, this is the one that illustrates (1) most poorly. First and most puzzling, both the tense [e] and the lax variant [ɛ] appear at the end of a word in an open syllable (both in the Brussels dialect under consideration and in Standard French). Minimal pairs are abundant, as exemplified in (17).

(17) Lexical contrast in word final position

[e]	[ɛ]
gré 'taste'	grès 'sandstone'
vallée 'valley'	valet 'butler'
aller 'to go'	allais 'went'
épée 'dagger'	épais 'thick'
poignée 'handful'	poignet 'wrist'

In spite of this fact, there is a tendency for [e] to be in an open syllable and for [ɛ] to be in a closed syllable. Here, too, examples are plentiful (at least before [ʀ]). The pairs in (18) are truly alternating pairs.

(18) Alternations

premier ~ première	'first, masc., fem.'
dernier ~ dernière	'last, masc., fem.'
boulanger ~ boulangère	'baker, masc., fem.'
charnier ~ charnière	'grave, hinge'

Finally and unexpectedly, no [e] is found before a consonant word finally.[9] In this position only [ɛ] is possible.[10]

(19) Only [ɛ] in word-final closed syllables

elle	'she'	tel	'such'
cette	'this, fem.'	renne	'reindeer'
cèpe	'cep'	bec	'beak'

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[9]   Gilles Boyé (p.c.) observes that the first class of verbs builds its infinitives without phonetic [ʀ]. This contrasts with all other classes of verbs, which realize [ʀ]. Assuming that the quality of the vowel cannot be changed, [ʀ] is impossible as a closing consonant, since it would violate the prohibition of [e] + consonant. The only viable solution is to delete [ʀ].

[10]   Clearly defined classes of exceptions are found in Brussels French, due to the influence of Flemish: *Linkebeek* [liŋkəbe:k], *Etterbeek*, and also *Kate* [ke:t], *cake* [ke:k], often pronounced with [ɛ] by Parisian French speakers.

The generalizations arising from the data discussed here are formulated in (20).

(20) Generalizations

a. Both [e] and [ɛ] in an open syllable, see (17).
b. No [e], but always [ɛ] before a final consonant (modulo some clearly defined exceptions).

To sum up section 2, it can safely be assumed that generalization (1) holds in French. This is particularly true for the pairs of rounded vowels and less so for the unrounded vowels. However, the image is not perfect, since, at the surface, one observes many tense vowels in apparently closed syllables (and lax [ɛ] is found in word-final open syllables). Moreover, some specific cooccurrence restrictions, like those shown in (7) and (12), render the generalization difficult to maintain in many cases. The next sections introduce a theoretical analysis explaining some of the deviant facts.

3.   The French Syllable

3.1   The facts

Since the OT account of the distribution of the lax and tense vowels in French to be developed below relies on a rather abstract analysis of syllable structure and on the assumption of the existence of semisyllables, both concepts must be introduced. This is the aim of the present section. The focus will be on the coda, but onsets and nuclei are also briefly considered.

First, onsets can be empty in French, which means that they are optional. Onsets have maximally three positions and always have an increasing sonority, as shown in (21). If the first segment is a stop, as in (21a), the second one may be a fricative, a liquid or a glide. In case the first segment is a fricative, as in (21b), the second one can be a liquid or a glide. And if the first one is a sonorant, as in (21c), the second one is also a sonorant, but of higher sonority. Whereas [w] and [ɥ] can be part of a triconsonantal onset, as in *truie* 'sow', *bruit* 'noise', *broie* 'crushes', and *cloître* 'cloister', this is impossible for [j]. In *brillant* 'bright', *plier* 'to fold', *triangle* 'triangle', and the like, [i] never becomes a glide. An explanation could be that the sonority distance between a sonorant and [j] is not sufficient for them to be part of one onset, while the sonority distance between a sonorant and [w] is. In other words, [j] is more consonantal (less sonorous) than [w] and [ɥ].[11]

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[11]   This result is compatible with Davis & Hammond's (1995) for Californian English. In this language, [w] is part of the onset and [j] part of the nucleus (it is also part of a diphthong).

(21) Onsets

   a. pχ (*près*), bʁ (*bras* 'arm'), gl (*glace* 'ice'), pw (*pois* 'pea'), kɥ (*cuire* 'to cook'), bɥ (*buisson* 'bush'), dj (*diable* 'devil'), gʁw (*groin* 'snout'), bʁɥ (*bruit* 'noise')

   b. fχ (*frère* 'brother'), vʁ (*vrai* 'true'), fl (*fleur* 'flower'), sw (*soie* 'silk'), zw (*zouave* 'Zouave'), ʒw (*joie* 'joy'), fɥ (*fuite* 'flight'), ʃj (*chien* 'dog')

   c. lw (*loi* 'law'), nɥ (*nuit* 'night'), ʁɥ (*ruine* 'ruin'), mj (*miel* 'honey'), ʁj (*rien* 'nothing')

Onsets always respect the Sonority Sequencing Principle formulated in (22a). The sonority hierarchy, following Clements (1990), is shown in (22b).

(22) Sonority

  a. Sonority Sequencing Principle

   The most sonorous segment of a syllable is the nucleus. From the nucleus to the edges of the syllable, segments are not of increasing sonority.

  b. Sonority Hierarchy

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| Stops | Fricatives | Nasals | Liquids (l, r) | Glides | Vowels |

Turning now to the postvocalic consonants, the picture is more complex. If more than one consonant follows the nucleus, the consonants can be of decreasing or of increasing sonority, and the sonority can also form a plateau, as shown in (23).

(23) Codas

a.	**Sonorant + Stop**	**Stop + Sonorant**
p r, l	harpe 'harp', Alpes 'Alps'	âpre 'rough', couple 'couple'
b r, l	Serbe 'Serb', (Elbe)	arbre 'tree', cable 'cable'
t r, l	verte 'green'	quatre 'four'
	moulte 'many'	
d r, l	garde 'keep'	cadre 'frame'
k r, l	orque 'killer whale'	ocre 'ocher', siècle 'century'
	calque 'tracing'	
g r, l	orgue 'organ'	aigre 'sour', aigle 'eagle'
	algue 'seaweed'	

b.	**s + Stop**	**Stop + s**

| p s | | laps 'period of time' |
| k s | risque 'risk' | axe 'axis' |

c. | **Sonorant + Fricative** | **Fricative + Sonorant** |

| f r, l | elf 'elf' | moufle 'mitten' |
| s m | clamse 'die' | matérialisme 'materialism' |

d. | **Sonor. + Sonor.** |

| r l | merle 'blackbird' |

e. | **Sonority plateau** |

| two stops | apte 'apt', acte 'act' |
| two fricatives | ours 'bear', offre 'offer' |

Two kinds of sequences which would be perfect from the point of view of the Sonority Sequencing Principle are nevertheless not allowed. First, a sequence consisting of a vowel plus a tautosyllabic nasal consonant followed by a consonant is usually excluded: such a sequence is replaced by a nasal vowel plus a consonant in nearly all cases (thus *bonne* [bɔn] 'good' but *bonté* [bɔ̃te] 'goodness'). The nonstandard *clamser* [klamse] 'to die' is an exception. Second, glides stand alone in the coda. There is no complex coda involving a glide, though there are complex onsets containing glides, as was shown in (21). To account for the distributional facts illustrated in (23), the syllable patterns in (24) and (25) are assumed. The syllable structure in (24) shows the 'normal' or default case. The onset can be absent, simple or complex, but the coda, if present, is always simple. To account for this, the syllable rime consists of at most two positions, one being the obligatory nucleus, the other a simple coda. Notice that the nucleus in French is always a vowel since French does not tolerate syllabic consonants.

(24) Core syllables

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        σ
      /   \
   Onset   Rime
           /  \
      Nucleus Coda
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v	a		(va 'goes')
pl	i		(pli 'fold')
b	ɔ̃		(bon 'good')
fl	y	t	(flûte 'flute')
m	a	l	(mal 'bad')
f	ɔ	χ	(fort 'strong')
vj	ɛ	j	(vieille 'old')
gʀ	ɔ	ɲ	(grogne 'moans')

This agrees with Dell's (1995) analysis of the French syllable (see also Bouchard 1980 and Dominicy 2000). Plénat (1987) also proposes that rimes consist maximally of two positions, but he assumes that the two rime slots can be occupied by sonorants only. He thus analyzes [l] in *mal* [mal] as part of the core syllable, but excludes [t] in *mat* [mat] from the coda. His main argument is that sonorants tend to be fixed and obstruents to be latent. This could be a bit too restrictive, since there are latent sonorants (like [ʀ] in adjectives such as *premier* or infinitive verbs, or the nasal emerging in a liaison context) and there are also fixed obstruents. Notice at this point that the present paper does not investigate the delicate problem of the latent consonants but is restricted to the representation of the fixed consonants, as far as they play a role in the distribution of the mid vowels.

The second type of syllable is more complex and consists of two syllables, a core syllable and a semisyllable, as shown in (25).

(25)   Core syllable   +   Semisyllable
             σ   σ
          /   \ |
     Onset   Rime   Onset
               /   \
          Nucleus Coda

f	ɔ	χ	t	(forte 'strong, fem.')
k	a	l	k	(calque 'tracing')
p	i		tχ	(pitre 'clown')
	a	ʁ	bʁ	(arbre 'tree')
sj	ɛ		kl̥	(siècle 'century')
d	u		bl	(double 'double')

The addition of the semisyllables allows an analysis in which all syllables respect the Sonority Hierarchy, not only the core ones but also the semisyllables, which must be understood as onsets of nucleusless syllables. Rimes of core syllables have maximally two positions. Compare the first two words in (23), the final consonants of which are organized in a mirror fashion (as in most words in the list in (23)). In *harpe*, the dorsal fricative [χ] is the coda and *p* is the semisyllable.[12] In *âpre*, on the other hand, both [p] and [χ] are parts of a semisyllable. The vowel [a] is longer in *âpre* than in *harpe*, at least in case the word is in a stressed position (see below). The reason why [p] is part of the semisyllable and is not a coda in the case of *âpre* has to do with the fact that onsets are maximized. The Onset Maximization Principle regularly applies in French, including in the semisyllables, and even – but to a lesser extent – across word boundaries (but see

---

12   The segment [ʀ] assimilates in voicing to an adjacent obstruent and is accordingly pronounced either as a voiceless uvular fricative [χ] or as voiced one [ʁ]. [l] is voiceless in this position. As far as the sonority is concerned, all variants behave as liquids.

Féry 2003 for exceptions). The other pairs of words in (23) behave similarly to *harpe* and *âpre*, although not all 'slots' on the list are occupied. Notice that French can readily add a nucleus to a semisyllable in the form of an epenthetic schwa. The reasons motivating the insertion of schwa in some contexts are not the subject of this paper. Here we concentrate on the abstract phonological syllable as it would be pronounced in careful speech at the end of a phrase, thus one in which no schwa is realized.

The syllable contact law (Vennemann 1986) is respected. Thus a word like *adroit* is syllabified maximizing the onset segments of the second syllable, thus delivering *a.droit* ([dʁ] is a possible onset), whereas a word like *ardoise* is syllabified as *ar.doise* since [ʁd] is not a possible onset. It would violate the Sonority Sequencing Principle.

Crucial for the following is the observation that words like *contre* [kɔ̃tχ] 'against', *autre* [otχ] 'other', *oncle* [ɔ̃kl̥] 'uncle', *simple* [sɛ̃pl̥] 'simple', etc., are frequent, but there are no words like **conrte* [kɔ̃χt], **aurte* [oχt], **onlque*, [ɔ̃lk], etc., in which the sonority of the two consonants is clearly falling (see (26)).[13] This distribution is an argument for the fact that the postvocalic consonants of this word are obligatorily relegated to a following semisyllable and cannot be distributed over the coda and a following onset. This is what is expected if the nasal vowels, as well as [o] and [ø], occupy two positions in the core syllable. Paradis & Prunet (2000) give a series of arguments for considering nasal vowels as bisegmental, for instance their propensity to be realized as an oral vowel plus nasal consonant as soon as they are followed by a vowel.[14]
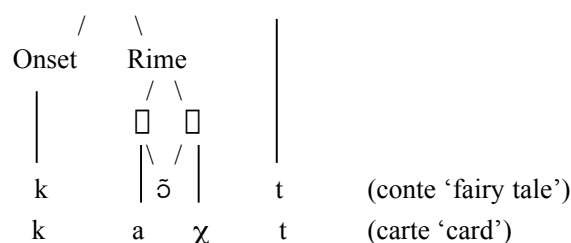
(26) No coda of decreasing sonority after bipositional (bimoraic) vowels

   a. *contre* [kɔ̃tχ] 'against', *autre* [otχ] 'other', *oncle* [ɔ̃kl̥] 'uncle', *simple* [sɛ̃pl̥] 'simple' …

   b. **conrte* [kɔ̃χt], **aurte* [oχt], **onlque* [ɔ̃lk]

   c. Maximal bimoraicity
         σ   σ

---

[13] There are a few words with a sonority plateau in the phonetic coda following these vowels, like *distincte* 'distinct, fem.', *Polyeucte* and a few words with [st] in their coda, like *holocauste* and *toast*. As a reviewer comments, at least the sequence [kt] is not a well-formed onset. These words can be considered as truly exceptional in having a bimoraic vowel followed by a coda + a semisyllable.

[14] Even though Paradis & Prunet (2000) propose an analysis of the French nasal vowels as bisegmental on the basis of the fact that they are usually "unpacked" (realized as a sequence of an oral vowel plus a nasal consonant) when they function as borrowings in languages without nasal vowels, they are said to be monomoraic. This result is based on O'Shaughnessy's (1981) measurements of vowel length where it was found that nasal vowels are just a little longer than oral ones, but much shorter than a sequence of an oral vowel plus a nasal. In my opinion, since moras are abstract phonological entities standing for syllable positions, and segments have a concrete phonetic implementation, an analysis like the one proposed in the present paper where nasal vowels are bimoraic but monosegmental is preferable.

```
        /  \
   Onset   Rime              |
     |      / \              |
     |     μ   μ             |
     |     |\ /|             |
     k     | ɔ |      t      (conte 'fairy tale')
     k     a   χ      t      (carte 'card')
```

Thus the next generalization is that the rime consists of maximally two positions, expressed in moras, which can be distributed over a nucleus and a coda or occur in a long nucleus. If the nucleus occupies two moras, there is no place for a tautosyllabic coda.

1.2   The Analysis

As the next step, consider an optimality-theoretic analysis of the French syllable using exclusively attested constraints, like the ones listed in (27). The basic idea of OT (Prince & Smolensky 1993) is very simple. It claims that Universal Grammar consists of a series of constraints, some of which are universally organized in a markedness hierarchy, but which are otherwise intrinsically unordered. The grammars of individual languages impose orderings upon this set of universal constraints, leading to differences between languages and thus to typological diversity. MAX in (27a) militates against deletion of segments, and DEP(ə) in (27b) against schwa epenthesis. These two constraints are typical faithfulness constraints, requiring faithfulness of the output to its corresponding input. In contrast, NUC in (27c) and NOCODA in (27d) are markedness constraints, requiring unmarked syllable structure. According to NUC, syllables must have a nucleus, and according to NOCODA, they should not have codas (see Prince & Smolensky 1993 and McCarthy & Prince 1993 for detailed accounts of the syllable structure in OT).

(27) Constraints for core syllables

   a. MAX: No deletion of segments
   b. DEP(ə): No schwa epenthesis
   c. NUC: Syllables have nuclei.
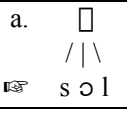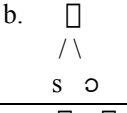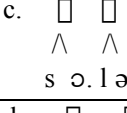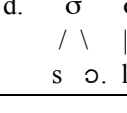   d. NOCODA: Syllables have no coda.

Tableau (28) shows a monosyllabic word with no complications, just an onset, a nucleus and a coda. Candidates are first generated and then evaluated by the constraint hierarchy, though the tableau shows both steps at once. The candidate best satisfying the hierarchy is the optimal, grammatical one. In this case, candidate a. with [l] as the coda is the optimal one. Candidates b. and c., with loss of a consonant and with an epenthetic vowel, are eliminated by high-ranking MAX and DEP(ə), respectively. Candidate d. is

suboptimal because there is a syllable without a nucleus and this is dispreferred, at least when no higher-ranking constraint forces this choice, as illustrated in tableau (28).

   A monosyllabic word like *calme* has a final consonant which cannot be part of the phonological coda because of the restriction on the number of rime positions. This has just been posited so far, but will be motivated below.

   In order to account for this kind of input, the additional constraints in (29) are needed. Tableau (30) illustrates the effect of the constraints. These constraints are undominated. In particular they dominate MAX and DEP, which can marginally be violated by optimal candidates.[15] First, SONHIER is a complex constraint to the effect that syllables obey the Sonority Sequencing Principle, formulated in (22). BIMOR restricts the number of moras in a syllable rime to two. And PARSE-SEG forces segments to be parsed into syllables. All the constraints used so far have been introduced by Prince & Smolensky (1993).

(28) Tableau for *sol* 'ground'

/sɔl/	MAX	DEP(ə)	NUC	NOCODA
a.　　σ 　　/ | \ ☞　s ɔ l				*
b.　　σ 　　/ \ 　　s　ɔ	*!			
c.　σ　σ 　∧　∧ 　s ɔ. l ə		*!		
d.　σ　σ 　/ \　| 　s　ɔ. l			*!	

(29) Constraints for semisyllables

   a. SONHIER: The margins of the syllable only consist of segments of decreasing sonority from the nucleus to the periphery.

   b. BIMOR: Syllable rimes are maximally bimoraic (or the rime consists of maximally two positions).

---

15   Dell (1995) observes that only sonorants after a stop can be unrealized in the onset of a semi-syllable. *Quatre* 'four' can be realized as [kat] and *arbre* 'tree' as [arb]. This realization is more probable in frequent words than in not so frequent ones, like *bacle* 'botch' or *ocre* 'ochre'. The pronunciation without a sonorant is mostly heard before words which begin with one or two consonants, as in *quat' garçons* 'four boys', *un arb' plein d'pommes* 'a tree full of apples'.

   c. PARSE-SEG: Segments belong to syllables.

In French, sequences of segments can be resyllabified across word boundaries, as is well known from the phenomena of liaison and enchaînement (see f.i. Encrevé 1986). As a consequence, semisyllables are prone to become onsets of following word initial onsetless syllables. This is also true of simple codas in words without semisyllables.

(30) Tableau for *calme* 'quiet'[16]

/kalm/	SONHIER	BIMOR	PARSE-SEG	MAX	DEP(ə)	NUC	NOCODA
a. σ σ / | \ | ☞ k a l. m						*	*

b. σ   σ
  / \ /\
  k a .l m
	*!						

c.   σ
  /|\\
  k a l m
		*!					**

d.   σ
  /|\
  k a l . m
			*!				*

e.   σ
  /|\
  k a l.
				*!			*

f. σ   σ
  /|\ /\
  k a l. m ə
					*!		*

---

[16] French treats its semisyllables in a different way than English and German. In French, a semisyllable is phonetically integrated into the preceding syllable and the result is a single articulated syllable, whereas a word like *middle* in the Germanic languages, consisting of a full syllable and a semisyllable is phonetically realized as two syllables. This difference is accounted for by the constraint NUC, violated in French by the semisyllables, but not by [l] of *middle* in English. In other words, it is the property of being a nucleus or not which decides on the phonetic syllabicity of semisyllables.

4.   Length and lengthening

4.1   Long and short vowels

Length and lengthening in French is a delicate matter, since it is dialect dependent and, even in Brussels French, where phonemic length is distinctive, some environments for its realization are far from being uncontroversial (see Dominicy 2000 f.i.). We will make the following assumptions here: a short lax vowel is by default monomoraic and a tense or a nasal vowel is always bimoraic. It must be observed, however, that moraicity is not automatically associated with length, rather it determines the number of tautosyllabic postvocalic consonants (see also Plénat 1987). Tenseness and laxness are orthogonal to length. Lax vowels may be long, and tense vowels short. Length must thus be considered as a potential, nonobligatory instantiation of bimoraicity.

The Brussels dialect of French has remnants of an earlier stage of the language in which, beside other properties, vowels were contrasted by length. Nowadays, the contrast is nearly only possible in the final syllable of a Phonological Phrase. Notice, however, that bimoraic vowels, i.e. tense [o], [ø] and the nasal vowels (see below for a motivation of this claim), do not contrast in moraicity. They are always bimoraic. Beside lexical contrast, length is also used as a gender marker in past participles and in adjectives ending in a vowel.

(31) Lexical contrasts in the vowel length (Brussels French)

	short	long	short	long
a.	il 'he'	île 'island'	abime 'damages'	abîme 'abyss'
b.	cru 'raw'	crue 'believed, fem.'	su 'known'	sue 'known, fem.'
c.	bette 'beet'	bête 'beast'	mettre 'put'	maître 'master'
d.	bout 'end'	boue 'mud'	loup 'wolf'	loue 'rent'
e.	mal 'bad'	mâle 'male'	patte 'paw'	pâte 'dough'

Beside this lexical and gender contrast, two kinds of "vowel lengthening" have been identified in the literature.

-    First, all vowels are long before a final voiced fricative [v, z, ʒ, ʁ], as illustrated in (32a).
-    Second, the bimoraic vowels (tense [o, ø] and the nasal vowels) are long before all final consonants (32b).

(32) Contexts of long vowels (Fouché 1959, Léon 1972, Malmberg 1969, Plénat 1987)
   a. All vowels are long before a final voiced fricative [v, z, ʒ , ʁ]:

cave [ka:v] 'cellar', lève [lɛ:v] 'lifts', chose [ʃo:z] 'thing', sauge [so:ʒ] 'sage', nage [na:ʒ] 'swims', beurre [bœ:ʁ] 'butter', lard [la:ʁ] 'bacon'

b. Some vowels (tense [o, ø] and the nasal vowels) are long before all final consonants:

ôte [o:t] 'takes away', saule [so:l] 'willow', heureuse [øʁø:z] 'happy', meute [mø:t] 'pack', longue [lɔ̃:g] 'long', dingue [dɛ̃:g] 'crazy', hanche [ɑ̃:ʃ] 'hip'

The lengthening affects only the last vowel of the last word in the Phonological Phrase, as illustrated in (33). *Lourd* in a. is long (or may be long) because it is final in its Phonological Phrase, but in b., since it is nonfinal, it can only be short.

(33) Lengthening in Phonological Phrase final position
    a. Long final vowel   b. Short nonfinal vowel
    c'est lourd [u:] 'it's heavy'   *le lourd* [u] *camion* 'the heavy truck'
    pauvre [o:] 'poor'   *pauvrement* [o] 'poorly'
    il est à la cave [a:] 'he is in the cellar'   *la cave* [a] *à vin* 'the wine cellar'

It is to be observed that many phonologists deny the reality of a systematic lengthening in (32). There is agreement, however, on the fact that these environments allow a vowel to be lengthened.

Consider next the contrast between the words in (34), showing that the syllable structure influence vowel length. The final vowels followed by two consonants, as in (34a), are always short, even when final in their Phonological Phrase. These vowels are in closed syllables, since the first of the two final consonants closes the syllable. Note that the two consonants in (34a) cannot form an onset together since the second consonant is of a sonority equal to or lower than that of the first one. The first consonant thus has no choice but be a coda, while the second consonant is obligatorily relegated into a following semisyllable. In contrast, the final vowels followed by one voiced fricative, as in (34b), are long. If length is expressed by bimoraicity, the long vowels in (34b) occupy the whole rime, and the following [ʁ] is a semisyllable (see also Charette 1991 for an insightful and detailed analysis of such contrasts in the framework of Government Phonology).

(34) Short stressed vowels in closed syllables vs. long stressed vowels in open syllables
    (see also Charette 1991)

    a. Short vowel   b. Long vowel

    ours [uχ.s] 'bear'   lourd [lu:.ʁ] 'heavy'
    heurte [œχ.t] 'hurts'   meurt [mœ:.ʁ] 'dies'
    verte [vɛχ.t] 'green, fem.'   vert [vɛ:.ʁ] 'green, masc.'

serve [sɛʁ.v] 'serves, subj.'   sert [sɛː.ʁ] 'serves, ind.'

The syllable structure assumed in this paper allows a simple explanation of the contrast observed in (34). In (34a) the syllable's two moras are occupied by a vowel and a consonant, and the vowel cannot become bimoraic. In (34b), the vowel, being alone in its rime can expand to bimoraicity, and often does so in the Phonological Phrase final position. The question arises why [ʁ] in (34b) is not the coda of the unique phonetic syllable. The explanation is that some consonants prefer to be onsets. This may be true of voiced fricatives in general - maybe even of voiced obstruents, though the universality of such an observation still needs to be validated.

Another factor leading to vowel length is the intrinsic bimoraicity of some vowels which occupy a whole rime. This is true of nasal and of tense vowels. These vowels relegate following consonants into a semisyllable. This is explained in detail in the next subsection, when an OT analysis is provided.

The tendency for final vowels to be long is a weak tendency, however, which is render invisible by many different factors. The question sometimes raised as to whether the lengthening observed in French is phonological or phonetic does not find a clear answer. Marc van Oostendorp (p.c.) observes that other languages, such as Scottish English and some dialects of Dutch, have the same kind of vowel lengthening before voiced fricatives, which is often characterized as phonetic. Plénat (1987) suggests that the length of tense and nasal vowels (32b) is more phonological than the length of all other vowels before a voiced fricative (32a). That vowels may be of different length is also confirmed by O'Shaughnessy (1981), who finds that vowels in Canadian French are longer in contexts such as in (32b) than those in (32a). Further authors who find lengthened vowels in this position are Barbosa & Bailly (1994), Delattre (1938) and Fletcher (1991) among others. However, the observed lengthening is not mandatory, and a vowel in the final position of a Phonological Phrase may be realized as short.

To sum up, the question as to why some preconsonantal final vowels can be long, but not all, finds an explanation in this framework. Vowels can be long only when phrase-final and in an open syllable, or in front of a semisyllable. Semisyllables arise in the following cases. First, some consonants are preferably onsets. Voiced fricatives in the final position are always onsets of semisyllables, which implies that a preceding vowel is always in an open syllable: *cave* is syllabified as [ka:.v]. This accounts for (32a). Second, some vowels are intrinsically bimoraic. This is true of tense vowels and of nasal vowels, both of which are long when stressed. Since syllables are maximally bimoraic, a following consonant obligatorily projects a semisyllable: *ôte* 'takes away' is syllabified as [o:.t]. This explains (32b). See the next subsection for more on this case.

A final and speculative remark in relation to the lengthening facts: there is a tendency in Parisian French to realize all words in (31) with a short vowel. Thus words which are pronounced with a long vowel in Brussels French, like f.i. *même* 'even' [mɛː.m], are realized with a short vowel in the Parisian dialect. An explanation for this change could be that Parisian French allows the final [m] of *même* to be the coda of the syllable, instead of being a semisyllable. As a result, length contrasts like those illustrated in (31) are being lost. If this observation is correct, the loss of length contrast

in Parisian French is simply the change from nonmoraic semi-syllables to moraic codas. Since the syllable cannot support more than two moras, the preceding vowel loses its mora to the coda consonant, and as a result, the vowel is obligatorily short.

1.2   An OT analysis of vowel length

To account for vowel length in OT, we need additional constraints. FINALLENGTH in (35a) predicts that Phonological Phrase final full syllables are bimoraic, and thus have the potentiality to be long. This constraint accounts for the fact that the lengthening affects only the last vowel of the last word in the Phonological Phrase. For closed syllables, bimoraicity is trivially fulfilled, but for final open syllables, however, the constraint says that vowels are bimoraic – thus long. In particular, this holds for the vowels immediately preceding a semisyllable and explains why some vowels are long even if they are phonetically closed by a consonant. This constraint, however, has only a weak effect in the phonology of French.

     *LONGV in (35b) requires vowels to be short, the universally unmarked length for vowels. The constraints (35a) and (35b) are in a so-called Paninian relation: *LONGV is a general constraint, saying something about all vowels, whereas FINALLENGTH requires that vowels are long in PhP-final syllables – a specific environment. For FINALLENGTH to have an effect, it must be ranked above *LONGV, otherwise *LONGV would eliminate long vowels in all environments. Overgeneralizing somewhat, it will be assumed in the following that all bimoraic vowels are long.

     CODACOND in (35c) is a language-dependent constraint (Itô 1989, Prince & Smolensky 1993) prohibiting certain segments or classes of segments in the coda, in the case of French the voiced fricatives. If high ranking, it classifies all voiced fricatives as onsets. In particular, the word-final voiced fricatives are forced to project a semisyllable, and (35a) forces a vowel preceding such a segment to be long.

     Finally, IDENT(μ) requires that if a vowel is specified for moraicity, as monomoraic or as bimoraic in the input, it will remain so in the output. This holds for bimoraic nasal vowels and for tense mid vowels,[17] as well as for the data in (31) generally, at least in the dialects which have retained the contrast. As a consequence of the bimoraicity of these vowels, a wordfinal consonant following a bimoraic vowel is forced to project a semisyllable, since the vowel already occupies the two moras of the syllable. IDENT(μ) is also responsible for the lexical contrast in (31). Monomoraic vowels emerge as short.

(35) Constraints for vowel length

     a. FINALLENGTH: PhP-final full syllables are bimoraic.
     b. *LONGV (No long vowel): Vowels are short.
     c. CODACOND: A voiced fricative is an onset.

---

[17]   Tense and nasal vowels could also be rendered long through the effect of a special constraint forcing these vowels to be long in the output, thus replacing the faithfulness analysis by a pure markedness one.

d. IDENT(μ): Moras from the input have correspondents in the output.

Tableau (36) shows that even though it is relatively low ranking, CODACOND is active in a word like *lourd*, in which the last consonant is a voiced fricative. Its effect is that [ʁ] is a semisyllable, and as a consequence the vowel [u], initially not specified as mono- or bimoraic, becomes bimoraic because of FINALLENGTH. It is not necessary to specify the moraicity of the vowels in the input of *ours*, since the constraints force it to be monomoraic in any case. Below, another strategy, leading to the same result, will be used: the two possible moraic specifications of the vowel will be in competition in the input.

(36) Tableau for *lourd* 'heavy'

	/luʁ/	SONHIER	BIMOR	FINALLENGTH	CODACOND	NUC	* LONGV
a. ☞	μ μ \ / lu.ʁ					*	*
b.	μ μμ \ / | luʁ.		*!		*		*
c.	μ | l u.ʁ			*!		*	
d.	μμ | | l uʁ.			*!	*		

Tableau (37) for *ours* illustrates why, given the constraint hierarchy assumed in the tableau, candidate a. is optimal. The voiced fricative cannot be an onset here, because of the presence of another fricative. Since relegating both fricatives in the onset would lead to a violation of SONHIER, /ʁ/ has no choice but being a coda. And as a consequence the vowel has to remain short. Since consonant clusters in French generally agree in voicing, /ʁ/ assimilates in voicing to /s/.[18] As a result of this assimilation /ʁ/ in *ours* surfaces as voiceless fricative [χ] whereas in a word like *lourd* or *fort* it is realized as a voiced fricative [ʁ], or approximant [ɹ̝] or marginally as a trill [ʀ].

(37) Tableau for *ours* 'bear'

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[18]   It may be interesting to mention that French patterns with Yiddish in Lombardi's (1999) typology, who uses the constraint UNIFORMITY to account for obstruent voicing assimilation.
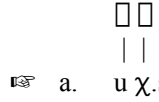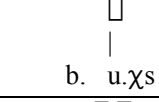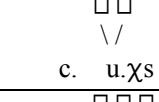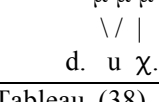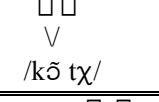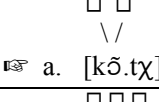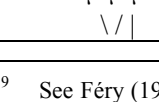
/uʀs/	SonHier	BiMor	FinalLength	CodaCond	Nuc	*LongV
☞ a. μ μ 　　| | 　　u χ.s					*	
b. μ 　　| 　　u.χs	*!		*		*	
c. μ μ 　　\ / 　　u.χs	*!				*	*
d. μ μ μ 　　\ / | 　　u χ.s		*!			*	*

Tableau (38) shows the working of IDENT(μ) for a lexically bimoraic vowel. The motivation for analyzing the tense and the nasal vowels as intrinsically bimoraic is twofold. First, as was mentioned in the preceding section, these vowels may be lengthened before all final consonants. This is expected if they are bimoraic.[19] Any subsequent consonants are relegated into a following semisyllable, since the two moras of the last full syllable of the word are made up by the vowels. The second reason is that whenever two consonants follow these vowels word finally they are of rising sonority. Recall that words like *contre* [kɔ̃tχ] 'against', *autre* [otχ] 'other', *oncle* [ɔ̃kl̥] 'uncle', *simple* [sɛ̃pl̥] 'simple', etc., are frequent, but there are no words like **conrte* [kɔ̃χt], **aurte* [oχt], **onlque*, [ɔ̃lk], etc. in which the sonority of the two consonants is falling (see (26)). This distribution must be taken as an argument for the fact that the postvocalic consonants must form an onset in these words and are not distributed over the coda and the following onset. Again, this is what is expected if the nasal vowels, as well as [o] and [ø] are bimoraic.

(38) Tableau for *contre* 'against'

μ μ 　\/ /kɔ̃ tχ/	IDENT(μ)	SonHier	BiMor	Max	Dep(ə)	*LongV
☞ a. μ μ 　　 \ / 　　[kɔ̃.tχ]						*
μ μ μ 　　 \ / |			*!			*

---

[19]　See Féry (1997) for an analysis of the German vowels along the same lines. In German, lax vowels are monomoraic and tense ones are bimoraic. Since stressed syllables are mandatorily bimoraic, stressed lax vowels are always in closed syllables.

b. [k ɔ̃ t.χ]						
μ μ | | c. [k ɔ̃ t .χ]	*!					

If a vowel is specified as monomoraic, as must be the case if the lexical distinction in (31) is to be audible, it does not lengthen. No tableau is provided for this case, since the effect can be deduced from what have been shown until now.

Lengthening is our first case of emergence of the unmarked. It only happens when there is no other factor countervening it, and it is not even clear whether it can be considered as a phonological alternation in all cases. In Brussels French, three environments are particularly prone to trigger a long vowel: a vowel before a semi-syllable, as in *lourd* and *vogue*, lexically long vowels as in *seau* and *pâte*, and finally the feminine ending as in *lue* and *jolie*. This last case can be understood as a process of mora epenthesis, and is probably the most phonologized case of all three.

Length is probably better analyzed as a gradient effect than as a categorical phenomenon, a fact that cannot be treated in detail in this paper (but see Féry to appear and 2003) for gradiency in French.

5.   Tense and lax mid vowels in OT

This section returns to the tense and lax vowels and proposes an OT account of their distribution. It was shown in section 2 that the general tendency for tense vowels is to be in an open syllable, whereas lax vowels tend to be in a closed syllable. However, as was shown in the preceding section, there is also a tendency for *all* final vowels to be long, regardless of their quality. For tense vowels, no contradiction arises, whereas for lax vowels in open syllables, there is a conflict. Lax vowels avoid open syllables, but when they are in a final open syllable before a semisyllable, they can be long, as in *or* and *beige*. This is expecially true for the Brussels dialect. This kind of conflict is hard to express in derivational models which derive surface forms from underlying representations with obligatory ordered rules. In OT, however, conflicts are expressed with ranked constraints, and since constraints are violable, it is expected that conflicts have to be solved one way or the other, depending on the input and on the ranking of the relevant constraints. As mentioned above, specific constraints have to be ranked higher than general ones in order to have an effect at all, and exemplifications of this principle will be shown in this section.

For the case at hand, the relevant constraints are those from the preceding sections and a new one, formulated in (39).[20] Some additional constraints are vowel-specific and will be introduced below.

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[20]   The question of which aspects of the vowels and/or the syllable structure are "underlying" and which are
     derived has been a much debated topic in generative phonology. Four possibilities have been considered in

(39) LAXV: Lax vowels are monomoraic.

The ranking IDENT(μ) >> CODACOND, FINALLENGTH >> *LONGV, LAXV accounts for the fact that only some lax vowels emerge as long (see the tableau for *or* 'gold' in (44)).

5.1 The alternation between [o] and [ɔ] in OT

The distributional properties of [o] and [ɔ] to be accounted for were formulated in (9) and are repeated in (40).

(40) Distribution of [o] and [ɔ]

　　a. Only [o] in an open syllable. Preferably [ɔ] in a closed syllable.
　　b. Only the tense back mid vowel [o] before [z].
　　c. Only the lax back mid vowel [ɔ] before voiced dorsal consonants.
　　d. Otherwise, in word-final position before a consonant, both variants are allowed.

These generalizations are organized from the general to the specific and it will be shown how constraints must also be organized on a domination scale going from specific to general to account for them. We start with the more general tendency in (40a).

　　The fact that only [o], and not [ɔ], is possible in an open final syllable is explained by the effect of LAXV, which demands that lax vowels be monomoraic. Since this contradicts the preference for vowels in final open syllables to be bimoraic (and thus to have the potentiality of lengthening), [o] is preferred, as shown in tableau (41) for *kilo*. Tense vowels are bimoraic and vowels in open final syllables are preferably bimoraic. Thus, there is no conflict. It is assumed that when the back vowel is final, its input is not specified for tenseness or laxness, nor is it specified for moraicity. A common way to express underspecification in OT is to allow for multiple inputs. The moras in parentheses correspond to the number of moras associated with the final vowel. Both candidates with bimoraic vowels (a. and c.) violate the constraint against long vowels, but the two candidates with monomoraic vowels (b. and d.) violate higher-ranking FINALLENGTH, and are thus eliminated. Candidate c., with a bimoraic lax vowel, violates LAXV, as well, and candidate a., which only violates low-ranking *LONGV, is the best candidate.

(41) Tableau for *kilo* 'kilo'

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detail for languages such as Dutch and German: vowel quality, vowel length, moraic structure and syllable structure. This problem is by far not as crucial in OT, since in principle each of these properties can be part of the input as long as the constraint hierarchy guarantees that all relevant properties correlate with each other.

/kilo, kilɔ/	FINALLENGTH	LAXV	*LONGV
☞ a. kilo (μμ)			*
b. kilo (μ)	*!		
c. kilɔ (μμ)		*!	*
d. kilɔ (μ)	*!		

The candidates for the interesting alternation *sot/sotte* 'silly' in (42) consist of masculine-feminine adjective pairs. The best pair in tableau (42) is the first one, in which the masculine adjective has a tense vowel in an open syllable and the feminine adjective has a lax vowel in a closed syllable. The moraic structure is not given in the tableau, but it is assumed that LAXV is fulfilled in all candidates, and thus that the lax vowels are monomoraic, and that tense [o] is always bimoraic.

It is not perfectly clear how to force the feminine forms to be in a closed syllable. One possibility could be to activate an additional constraint, called FEM(C), requiring feminine adjectives to end in a consonant. At first sight, this constraint being language specific, is not a good OT constraint, but if it is understood as a special case of a more general constraint positing that the feminine forms are phonologically more complex than their masculine counterparts (as was also the case in (31)), it becomes universal after all (see also Féry 2003 for an OT account of prenominal adjectives). An antifaithfulness constraint just requiring the masculine and the feminine to be different (see Alderete 2001) would not be enough.

(42) Tableau for *sot/sotte* 'silly'

/so, sɔ, sot, sɔt/	FINALLENGTH	FEM(C)	NUC	NOCODA
☞ a. .so./.sɔt.				*
b. .so./.so.t.			*!	
c. .sɔ./.sɔt.	*!			*
d. .sɔt./.so.		*!		*

An advantage of the account proposed here is that the quality of the vowel in the alternation is fully predictable: it is tense in the masculine because it is in an open syllable and lax in the feminine because it is in a closed syllable. No assumption must be made about the underlying quality of the o-segment. The input consists of all combinatorial variants of the allophones found in this word, which replaces underspecification of the relevant features.

Turning now to (40b), the fact that only [o] is found before [z] supports the analysis proposed above that voiced fricatives prefer to be onsets. If, in the words in (7a), [z] is the onset of a semisyllable, the preceding o-sound is in an open syllable and must be bimoraic, and thus tense, since it is the final vowel. Compare the tableau for *lourd* in (37).

However, some special cases of (7b), accounted for in (40c), present a problem. First, vowels preceding [ʁ] are lax. This can be expressed by the constraint LAXINGHARMONY, which says that [ʁ] is preceded by a lax vowel. This harmony between [ʁ] and a preceding lax vowel is found in several languages, as for instance in some dialects of German (see Hiller 1995).

(43) LAXINGHARMONY: [ʁ] is preceded by a lax vowel.

LAXV and FINALLENGTH, requiring [o.ʁ], conflict with LAXINGHARMONY, which militates against such a sequence, since [o] is a tense vowel. In derivational phonology, this would be accounted for by ordered rules in a disjunctive relation. In OT, in a situation in which FINALLENGTH is satisfied, the sequence [ɔ.ʁ] or [o.ʁ] will be chosen, depending on which constraint is ranked higher. In our special case, LAXINGHARMONY is ranked higher than CODACOND, which means that [ɔ.ʁ] emerges as the best candidate.[21] In other words, LAXINGHARMONY is more specific than CODACOND since it makes prediction about one consonant and a class of vowels, whereas CODACOND concerns a class of consonants.

(44) Tableau for *or* 'gold'

/ɔʁ, oʁ/	LAXING HARMONY	FINALLENGTH	CODACOND	LAXV	*LONGV
☞ .ɔː.ʁ.				*	*
.ɔ.ʁ.		*!			
.oː.ʁ.	*!				*
.oʁ.	*!		*		
.ɔʁ.			*!		

The next context that we need to consider is the class of the four dorsal voiced consonants [g], [ɲ], [ŋ] and [ʁ], defined in (40c). As was shown in (7b), only [ɔ] is allowed before these consonants. Thus we need a constraint on an even more restricted class of segments: just one vowel and the voiced dorsal consonants. We can express this with the help of the constraint BACKNESS, formulated in (45). Notice that BACKNESS makes the same prediction as LAXINGHARMONY as far as [ʁ] is concerned, but LAXINGHARMONY is more general since it also accounts for the laxing of the other mid vowels before [ʁ]. BACKNESS must be ranked higher than FINALLENGTH since this last constraint has the effect of relegating a final consonant into a semi-syllable, and this is not what happens by default in the case of [ɔ] + voiced dorsal C.

(45) BACKNESS

Before a voiced dorsal consonant, only a lax back mid vowel is allowed
(*[o] + voiced dorsal C).

The last series of cases are the most specific ones mentioned in (40d). Before most
consonants, both variants of the back mid vowel are allowed. To account for this lexical
distinction, we need faithfulness to a property of a specific segment in a specific lexical
item, here the constraint IDENT(μ). A word like *paume* 'palm' in which the o-sound is
always tense is accounted for by the lexically prespecified bimoraicity of the vowel. The
final consonant is a semisyllable. This is shown in Tableau (46). In *pomme* 'apple', with
a lax vowel, no prespecification is needed. The segment [m] is the coda of the syllable,
and the whole word is syllabified like *sol* in (28).

(46) Tableau for *paume* 'palm'

μ μ ∨ /p o m/	IDENT(μ)	BIMOR	FINALLENGTH	CODACOND	*LONGV
a. μ μ \ / ☞ [p o .m]					*
b. μ μ μ \ / | [p o m]		*!			*
c. μ | [p o .m]	*!		*		
d. μ μ | | [p o m]	*!				

The constraint hierarchy given in (47) has been used in this subsection to account for the
alternation between the two round back mid vowels [o] and [ɔ]. IDENT(μ) is the highest
ranking constraint, responsible for the lexical length contrast on vowels. BACKNESS and
LAXINGHARMONY are next on the hierarchy and are responsible for specific featural
cooccurrence restrictions. The remaining constraints are relevant for the length of all
vowels, not only the mid ones, and as such are responsible for what happens in the
default cases. They are responsible for the emergence of the unmarked (McCarthy &
Prince 1994.

(47) Constraint hierarchy for the round back mid vowels [o] and [ɔ]

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21   Notice that *lourd* in (37) is not affected by LAXINGHARMONY since there are no lax high vowels
      in standard French. This is accounted for by a cooccurrence restriction against [high, lax].

IDENT(μ), BIMOR >> BACKNESS, LAXINGHARMONY >> FINALLENGTH >> CODACOND >> LAXV >> NUC

5.2 The alternation between [ø] and [œ] in OT

The second pair of mid vowels, [ø] and [œ] needs two more constraints, making specific claims on this pair of vowels. First, recall the distributional properties to be accounted for. (16) is repeated as (48).

(48) Distribution of [ø] and [œ]

     a. Only [ø] in an open syllable. Preferably [œ] in a closed syllable.
     b. Before a coronal obstruent, only [ø] is allowed.
     c. Otherwise, in word-final position before a consonant, nearly only [œ].

The constraints used so far are sufficient to account for the first generalization, that is the fact that only the tense variant is found in open syllables and that [œ] is preferred in closed syllables. This is the same generalization as observed for the o-sounds and formulated in (40a). Tableaux (49) and (50) show how the distribution of [ø] and [œ] is obtained in the alternation between *veut* and *veulent* (open vs. closed syllable).

(49) Tableau for *veut* 'want, 3rd pers. sg.'

/vø/, /vœ/	BIMOR	FINALLENGTH	LAXV	*LONGV
☞ a. .vø. (μμ)				*
b. .vœ. (μ)		*!		
c. .vœ. (μμ)			*!	*

(50) Tableau for *veulent* 'want, 3rd pers. pl.'

/vøl/, /vœl./	BIMOR	FINALLENGTH	LAXV	*LONGV
a. .vøl. (μμ)	*!			*
☞ b. .vœl. (μ)				

The second generalization in (48b) says that only tense [ø] is allowed before a coronal obstruent, thus only [ø] appears before [t], [d], [z] or [ʒ] (as in *Maubeuge*). For the voiced coronal fricatives, no new constraint is needed since the ones introduced so far correctly predict that voiced fricatives form a semisyllable.

(51) Tableau for *gueuse* 'lass'

/gøz, gœz/	BiMor	CodaCond	LaxV	*LongV	Nuc	NoCoda
☞ a. .gøː.z. (μμ)				*	*	
b. .gøz. (μμ)	*!	*				*
c. .gœ.z. (μμ)			*!	*	*	
d. .gœz. (μ)		*!				*

However, for words like *émeute*, *feutre*, and *Eudes*, with a coronal stop after the tense [ø], an additional, higher-ranking constraint in (52) is needed to account for the lack of [œ] before coronals. This constraint conflicts with the other constraints responsible for the alternation between tense and lax vowels, since a vowel followed by a consonant other than a voiced fricative should form a closed syllable, in which case the lax variant of the vowel is expected. WE are again faced with a case in which a specific constraint must be ranked higher than the general ones in order to have an effect at all. The effect of *[œ]Coronal is illustrated in (53).

(52) *[œ]Coronal

   Before a coronal obstruent, only the tense variant of the front mid round vowel is allowed.

(53) Tableau for *meute* 'pack'

/møt, mœt/	*[œ]Cor	FinalLength	LaxV	*LongV	Nuc
☞ a. .møː.t.				*	*
b. .mœː.t.	*!		*	*	*
c. .mœt.	*!	*			

Words like *veuve* and *meuble*, with a lax vowel in a context where a tense vowel is expected, are accounted for by a constraint prohibiting [ø], ranked below *[œ]Coronal. These constraints are in a clear Paninian relationship with each other, since (54) prohibits [ø] in all contexts and *[œ]Coronal prohibits the lax variant in a specific context.

(54) *[ø]

Finally, for the speakers who have the contrasts *jeune/jeûne* or *meule/meule* (cf. (14)), a specific faithfulness constraint, like Ident(μ), is needed by means of which the contrasting quality of the vowels can be maintained. The contrast must be lexically specified. The effect of the faithfulness constraint was illustrated above for *paume/pomme* and is not repeated here.

   The same kind of constraint hierarchy as the one which has been shown to be active in the alternation between the back mid vowels has been established here. The most specific constraints are of course different from the ones for [o] and [ɔ], except for the one responsible for preserving the lexical prespecification of the moras.

(55) Constraint hierarchy for the round front mid vowels [ø] and [œ]

IDENT(μ), BIMOR >> *[œ]CORONAL >> *[ø] >> FINALLENGTH >> CODACOND >> LAXV >> NUC

5. 3 The alternation between [e] and [ɛ] in OT

This section examines the last pair of mid vowels, the unrounded front ones, [e] and [ɛ]. The generalizations are repeated from (20).

(56) Distribution of [e] and [ɛ]

  a.   Both [e] and [ɛ] in an open syllable.
  b.   No [e], but always [ɛ] before a final consonant (modulo some clearly defined exceptions).

Just one additional constraint is needed which prohibits word-final [e] before all consonants, tautosyllabic or not, which is formulated in (57). This constraint aims at blocking the emergence of [e] in a phonetically closed syllable.

(57) *[e]C: No word-final [e] before a consonant

If this constraint is ranked higher than the constraint against long lax vowels, it also blocks the emergence of [e] before a voiced fricative, where a long vowel is expected, as would be required by CODACOND and FINALLENGTH.

(58) Tableau for *beige* 'beige'

/bɛʒ, beʒ/	*[e]C	FINALLENGTH	CODACOND	LAXV	*LONGV	NUC
a. bɛ.ʒ (μ)		*!				*
☞ b. bɛː.ʒ (μμ)				*	*	*
c. be.ʒ (μ)	*!	*				*
d. beː.ʒ (μμ)	*!				*	*

The fact that both [e] and [ɛ] are contrastive in the word-final position can be accounted for by the faithfulness constraint IDENT(μ). Note that the quality of this vowel is subject to a great deal of variation and has been the theme of extensive studies, such as Martinet & Walter (1973). In Brussels French, the emergence of lax vowels in absolute final postion is easier than in Parisian French, which can be explained by a lesser tendency of the open syllable to favor vowel tenseness.

The tendency to have lax vowels in closed syllables and tense vowels in open syllables can be observed in pairs of related words, like *taper/tapette*. In the open syllable, the tense variant is realized, and in the closed syllable the lax one. The relevant environment is somewhat blurred by other influences, like the admissibility of both sounds in the absolute final position, the lexical resemblance and the neutralization of the vowel quality in nonfinal syllables (see Léon 1972 for a careful overview of the factors responsible for the choice of the one or the other vowel).

(59) Constraint hierarchy for the mid front unrounded vowels [e] and [ɛ]

IDENT(μ), BIMOR >> *[e]C >> FINALLENGTH >> CODACOND >> LAXV >> NUC

Before we conclude, let us add a few remarks on the implementation of the tense/lax alternations in different varieties of French. It has been observed repeatedly in the literature that Meridional French respects the *loi de position* to a greater extent than other dialects (Dominicy 2000, Morin 1986 and Plénat 1987 a.o.). And Quebec French shows a larger inventory of lax vowels as compared to European French (Bouchard 1980, Charette 1991, Morin 1986). These differences have been largely ignored in the present paper. An OT account, however, like the one presented in the preceding pages, readily accounts for dialectal variations, as well as for language change. The architecture of OT, which consists of a set of universal constraints and which envisages particular grammars as as many rankings of the constraints, allows for variation inside of a language in a strikingly simple way. Changes, dialectal, stylistic, or even diachronic is rendered by reranking of the universal constraints. The scope of this paper is limited to an formal account of a limited set of data in a particularly interesting variety of French and does not allow an account of variation, though the interest of developing a more sociolinguistically oriented model should be evident.

6.   Conclusion

The generalization expressed in (1) which states that lax vowels occur in closed syllables and tense vowels in open syllables holds in French, though it is obscured by a number of idiosyncrasies mostly having to do with restrictions between classes of segments or even between particular vowels and consonants. The analysis advanced in this paper relies heavily on the existence of semisyllables, which have been shown to be necessary in the phonology of several languages (see, for example, Cho & King 2002 for Georgian, Polish and Bella Coola, Féry 2002 for German Kiparky 2002 for Arabic and Green 2002 for Irish).

OT is an ideal framework to account for the intricate data presented above, since the effect of unmarkedness can be overridden by more specific constraints acting toward

more markedness. The complete list of constraints necessary to account for French are listed in (60).

(60) Constraint ranking for French

SONHIER, BIMOR, IDENT(μ) >> *[e]C, BACKNESS, LAXINGHARMONY, *[œ]CORONAL >> *[ø], MAX, DEP(ə) >> FINALLENGTH >> CODACOND >> LAXV >> *LONGV, NUC >> NOCODA

The constraints relevant for the distribution of pairs of lax and tense vowels are in a Paninian relationship, with the more specific ones ranked higher than the general ones. Constraints aiming at preserving lexical prespecifications must be ordered highest in the hierarchy; in second position, we find constraints involving classes of segments, and at the bottom of the hierarchy, the most general constraints. The more specific constraints we find, the less probable it is that the general ones will play be active in determining the optimal candidates, and the less we see the effects of Emergence of the Unmarked. In French, the unmarked case for the distribution of vowels is that a lax vowel is closed by a consonant and a tense vowel is in an open syllable. In languages in which the constraints requiring fulfillment of these tendencies are high in the constraint hierarchy, as they are in many Germanic languages, their effects are more immediately observable than in languages like French, where a whole series of more specific constraints obliterate their effects.

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Caroline Féry (fery@rz.uni-potsdam.de)
Institute of Linguistics- University of Potsdam
Postfach 601553
14415 Potsdam - Germany