CONSONANT CLUSTER PHONOTACTICS: A PERCEPTUAL APPROACH

by

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À ma mère et à mon bébé,
    qui nous ont quittés
À Marielle et Émile,
    qui nous sont arrivés
À Jean-Pierre,
    qui est toujours là

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ABSTRACT

This dissertation deals with deletion and epenthesis processes conditioned or constrained by the consonantal environment, essentially consonant deletion, vowel epenthesis, and vowel deletion. It is argued that the standard generative approach to these processes, which relies on the syllable and the principle of prosodic licensing, is empirically inadequate, and an alternative sequential approach based on perceptual factors is developed. It is proposed that the likelihood that a consonant deletes, triggers epenthesis, or blocks vowel deletion correlates with the quality and quantity of the auditory cues associated to it in a given context. The approach is implemented in Optimality Theory and adopts more specifically the 'Licensing by cue' framework developed by Steriade (1999a,c).

New empirical gneralizations concerning deletion and epenthesis processes are uncovered, in particular 1) the fact that stops are more likely than other consonants to delete, trigger epenthesis, or block deletion; 2) the role of syntagmatic contrast in deletion and epenthesis processes; 3) the role of the audibility of stop release bursts; 4) the existence of cumulative edge effects, whereby more and more phonotactic combinations are licensed at the edges of prosodic domains as we go up the prosodic hierarchy. These generalizations are elucidated in terms of internal and contextual cues, modulation in the acoustic signal, and cue enhancement processes at edges of prosodic domains.

The proposed perceptual approach achieves a substantial simplification and unification of the conceptual apparatus necessary to analyze deletion and epenthesis processes. It subsumes under the more general notion of perceptual salience principles of syllable well-formedness and the Obligatory Contour Principle. Furthermore, it eliminates the need for exceptional mechanisms such as extrasyllabicity at domain edges.

The analysis is based on the study of deletion and epenthesis processes in a variety of languages. Detailed investigations of schwa in Parisian French, cluster simplification in Québec French, and stop deletion and vowel epenthesis in Ondarroa Basque are provided.

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**NOTES ON THE PRESENT VERSION**

The present version, finished in July 2001, differs slightly from the official one, deposited in September 2000. The acknowledgments were finally added. The formatting was changed and the presentation generally improved. Several typos were corrected, and the references were updated, when papers originally cited as manuscripts were subsequently published. A couple of references were also added, as well as short conclusions to chapters 3, 4, and 5, which for the most part summarize the chapter in question.

Occasionally I have modified the text, for stylistic or clarificational reasons, without altering the original meaning. The modifications brought to the following sections deserve to be specifically mentioned:
- section 3.2.3: The discussion of Fleischhacker's analysis on pp. 171-173 was slightly modified in light of Fleischhacker (2000a).
- section 3.3.1: Explanations were provided for the tableau in (44).
- section 4.2.2: The percentage of deletion for obstruent+/t,d/ clusters was added, with corresponding revisions of the following paragraph.

I have adopted two simple terminological changes, which have no effect on the analysis, and have modified the text accordingly:
- The feature [continuant$_{ac}$] was changed to [noisy] (sections 4.3.3.1.4 and 4.3.3.2)
- The constraint MAX-C[+F$_M$] was changed to MAX-C(-stop) (sections 3.2.3, 3.3.2, 4.2.4, and 4.3.3.2)

I wanted to keep more significant changes to a minimum and only revised a few sections which I felt needed to be. These are:
- section 3.2.3: The constraint MAX-stop/__[+cont] was added in (29) and (35).
- section 4.1.2.2: The discussion of relative identity avoidance was revised, in particular with the addition of the Hungarian pattern.
- section 4.2.4: The analysis of Hungarian was changed.
- section 4.3.1: A few clusters were added in table 5, and its presentation was slightly modified. The discussion of previous analyses was revised, in particular in light of Nikièma (1999), which was not available when the dissertation was officially deposited.
- section 5.4.4.3: The rule for the positioning of the /-a/ morpheme was revised.
- section 5.4.6: The constraint ranking was maintained but tableaux and explanations were added, together with a discussion of likelihood and gradient well-formedness of competing forms.
- section 5.4.7: The section was generally improved.

Questions and comments are welcome.
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# INTRODUCTION

This dissertation deals with deletion and epenthesis processes conditioned or constrained by the consonantal environment. These are essentially consonant deletion, vowel epenthesis, and vowel deletion.[1] Consonant deletion and vowel epenthesis serve to avoid consonants in certain disfavored positions; vowel deletion may be blocked when it would yield an undesirable consonantal configuration.

The standard generative approach to these processes relies on the syllable and the principle of prosodic licensing, which states that all phonological units must be prosodically licensed, that is they must belong to higher prosodic structure. In particular, segments must belong to syllables. Under this view, consonant deletion and vowel epenthesis serve to achieve exhaustive syllabification of the segmental string, when a consonant cannot be incorporated into a well-formed syllable. Likewise, vowel deletion is blocked when this would leave a consonant that cannot be properly syllabified.

I argue against the traditional syllabically-conditioned analyses of these phenomena, on empirical as well as conceptual grounds, and claim that syllable well-formedness plays no role in them. I develop an alternative sequential approach which highlights the role of perceptual factors. The basic idea is encoded in a Principle of Perceptual Salience, according to which every segment must be sufficiently salient. A consonant deletes or triggers epenthesis when the cues that permit a listener to detect its presence are diminished. Deletion removes such deficient segments, epenthesis provides them with additional salience. Likewise, vowel deletion is blocked when this would leave a consonant with diminished perceptual cues. Maintaining the vowel avoids removing cues that are crucial to that consonant. The likelihood that a certain consonant deletes, triggers epenthesis, or blocks vowel deletion correlates with the quality and quantity of the auditory cues associated to it in a given context.

This approach is implemented in Optimality Theory and uses phonetically-motivated constraints projected from observable phonetic properties. This investigation pursues a more general line of research that has been developing recently and that reassesses the role of the syllable in segmental processes and explores the contribution of perceptual factors (e.g. Flemming 1995; Jun 1995; Côté 1997a, 1999; Boersma 1998, 1999; Hume 1999; Y. Kang 1999, 2000; Kochetov 1999; Steriade 1999a,c,d, to appear; Hume & Johnson, to appear). It adopts more specifically the 'Licensing by cue' approach developed by Steriade (1999a,c), according to which the likelihood that a feature or segment occurs in a given context is a function of the relative perceptibility of that feature or segment in that context.

It is argued that a perception-based sequential approach is superior to those based on syllable well-formedness because it achieves significantly greater empirical coverage as well as a substantial simplification and unification of the conceptual apparatus necessary to analyze deletion and epenthesis processes. New empirical generalizations concerning these processes are uncovered, in particular 1) the fact that stops are more likely than other consonants to delete, trigger epenthesis, or block deletion; 2) the role of syntagmatic contrast in deletion and epenthesis processes: consonants that are more similar to adjacent segments are more likely to delete or trigger vowel epenthesis than consonants that are more contrastive; 3) the role of the audibility of stop release bursts; 4) the existence of cumulative edge effects, whereby more and more phonotactic combinations are licensed at the edges of prosodic domains as we go up the prosodic hierarchy, thereby reducing the likelihood of consonant deletion and vowel epenthesis and increasing that of vowel deletion. These generalizations are elucidated in terms of internal and contextual cues, modulation in the acoustic signal, and cue enhancement processes at edges of prosodic domains.

This perceptually-motivated approach integrates principles that were thought to be independent under the more general notion of perceptual salience: on the one hand, principles of syllable well-formedness, on the other hand, the Obligatory Contour Principle. Furthermore, it eliminates the need for exceptional mechanisms such as extrasyllabicity at domain edges. The resulting theory is more coherent as it unifies phenomena that are similar but for which radically different principles had been invoked.

The irrelevance of syllable well-formedness has been argued for with respect to processes other than consonant deletion and vowel epenthesis, notably laryngeal contrasts (Steriade 1999a,c), place contrasts (Steriade 1999a), and palatalization (Kochetov 1999). These results raise the possibility that the syllable could be

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[1]This is not to say that all instances of consonant deletion, vowel epenthesis, and vowel deletion are motivated by the consonantal environment. Vowel epenthesis may be driven, and vowel deletion blocked, by rhythmic constraints, for example the desire to avoid final stress, achieve a well-formed trochee (e.g. French, Fagyal 1998, 2000; Galician, Martínez-Gil 1997), or conform to minimal-word conditions (e.g. Mohawk, Hagstrom 1997; Lardil, K. Hale 1973). Consonant lenition, which may result in complete deletion, also typically applies intervocalically (Kirchner 1998; Lavoie 2000).

dispensed with in all segmental phonology. However, this conclusion is not to be taken as implying that syllables are devoid of any phonological status. It is well beyond the scope of this dissertation to determine the exact role of the syllable in phonology, but one plausible scenario is to view the syllable as a purely rhythmic constituent, which is crucial in accounting for rhythmic processes (e.g. shortening in closed syllables, lengthening in open or stressed syllables, stress on heavy syllables) but is irrelevant for segmental ones. I leave for future research the exploration of this and other issues related to the scope of syllable structure in phonology.

The dissertation is organized as follows.

Chapter 1 introduces the syllabic approach to deletion and epenthesis and evaluates its empirical coverage. This approach is argued to be insufficient, unnecessary, and inadequate. I discuss several deletion and epenthesis processes for which a syllabic account has been proposed and show that it does not hold upon closer examination of the facts. These patterns are consonant deletion in Hungarian, Attic Greek, English, and Icelandic, and vowel epenthesis and deletion in French. Given the complexity of the French case, it is discussed in chapter 2, entirely devoted to the French schwa. While showing the inadequacy of syllable-based analyses, these patterns also reveal generalizations and tendencies in the application of deletion and epenthesis. These constitute the empirical basis of the dissertation, which the framework developed in subsequent chapters is meant to account for. These generalizations are:
1: Consonants want to be adjacent to a vowel, and preferably followed by a vowel.
2: Stops want to be adjacent to a vowel, and preferably followed by a vowel.
3: Stops that are not followed by a [+cont] segment want to be adjacent to a vowel.
4: Consonants that are relatively similar to an adjacent segment want to be adjacent to a vowel, and preferably followed by a vowel.
5: Consonants that do not surface at the edge of a prosodic domain want to be adjacent to a vowel, and preferably followed by a vowel.
6: Coronal stops want to be followed by a vowel.

Chapter 3 presents the perceptual motivations that underlie the generalizations presented in chapters 1 and 2 and develops an Optimality-theoretic constraint system that derives these generalizations and yields the desired patterns of consonant deletion, vowel epenthesis, and vowel deletion. I argue that both markedness and faithfulness constraints encode the desirability of perceptual salience. I also discuss a number of issues that this perceptually-motivated analysis raises, notably the role of phonetics and perception in synchronic grammars and the treatment of variation in Optimality Theory. I end the chapter with two simple case studies to illustrate the functioning of the constraint system I propose: Lenakel vowel epenthesis and Sranan consonant deletion.

Chapters 4 and 5 expand on two of the factors that were shown to affect consonant deletion, vowel epenthesis, and vowel deletion in the previous chapters: syntagmatic contrast and the prosodic structure. Chapter 4 is concerned with the role of syntagmatic contrast in consonant deletion and vowel epenthesis. It elaborates on the generalization noted in chapters 1 and 2 that consonants that are more similar to adjacent segments are more likely to delete or trigger epenthesis than consonants that are more contrastive. The approach to syntagmatic contrast presented in chapter 3 is compared with previously proposed ones, in particular the OCP. It is concluded that this principle fails to account for the full range of effects of identity or similarity avoidance. Then I apply the proposed system to several case studies of consonant deletion and vowel epenthesis, in order of increasing complexity. Catalan, Black English, and French illustrate the role of agreement in place of articulation, voicing, and manner of articulation in deletion and epenthesis patterns. Hungarian shows the possible interaction of manner and place of articulation. Finally, I analyze in detail the very complex pattern of word-final cluster simplification in Québec French, which most clearly illustrates the gradient effect of similarity on consonant deletion.

In chapter 5 I investigate in more detail what I call edge effects, which refer to the fact that more complex combinations of consonants are typically allowed at edges of prosodic domains, as opposed to domain-internal positions. The greater tolerance for consonant clusters at edges explains the presence of asymmetries in the application of deletion and epenthesis processes between internal positions and edges of constituents. Edge effects have been investigated almost exclusively at the word level. This chapter expands the empirical basis of edge effects by looking at patterns of consonant deletion, vowel epenthesis, and vowel deletion that display edge effects at levels above the word, and showing the cumulativity of edge effects, whereby consonants are more and more easily tolerated as we go up the prosodic hierarchy. We will see how the perceptual approach advocated here naturally and simply accounts for edge effects and their cumulative behavior, without the need for exceptional mechanisms such as extrasyllabicity. This approach relies on the existence of cue enhancement processes at edges of prosodic domains, which increase the perceptibility of consonants in these positions. The patterns analyzed in this chapter include epenthesis and deletion in Arabic, French, Picard, and Marais-Vendéen. I develop in greater detail one case study: consonant deletion and vowel epenthesis in Basque, with special emphasis on the dialect of Ondarroa.

## Chapter 1

## AGAINST THE SYLLABIC APPROACH

## TO DELETION AND EPENTHESIS

The aim of this chapter is twofold: 1) it introduces the syllabic approach to deletion and epenthesis and evaluates its empirical coverage, and 2) it presents a number of empirical generalizations concerning these processes, which the framework developed in chapters 3-5 is meant to account for.

Deletion and epenthesis are standardly assumed to follow from the principle of prosodic licensing, and specifically the requirement of exhaustive syllabification, whose application is conditioned by syllable well-formedness conditions. I argue against this approach, on the basis that it is:

*-insufficient*:     It cannot account for all cases of deletion and epenthesis and must be supplemented by independent principles;

*-inadequate*:     Several cases for which a syllabic account has been proposed turn out to be incompatible with a non-circular definition of the syllable;

*-unnecessary*:     In syllable-based analyses that are not empirically problematic, it appears that the syllabic level is unnecessary, as an equally simple sequential analysis is available.

The bulk of the discussion is devoted to the inadequacy problem. I present five cases of consonant deletion, vowel epenthesis, and vowel deletion which are standardly analyzed in syllabic terms, and show that this approach does not hold upon close examination of the facts. These patterns are consonant deletion in Hungarian, Attic Greek, English, and Icelandic, and vowel epenthesis and deletion in French. Given the complexity of the latter case, it is discussed in the following chapter, entirely devoted to the French schwa.

While showing the inadequacy of syllable-based analyses, these patterns also reveal generalizations and tendencies in the application of deletion and epenthesis which constitute the main empirical achievement of the dissertation. The discussion thus integrates critical analysis and constructive propositions. These generalizations are sequential in nature, a property that will be crucially reflected in the analysis I develop in the following chapters.

### 1.1. THE SYLLABIC APPROACH: ELEMENTS

It is a strange thing that the existence of the syllable in languages is generally evident but linguists are at a loss as to its role in the language (...) (Krámský 1971: 45)

### 1.1.1. FROM SPE TO PROSODIC PHONOLOGY

In generative phonology, the *Sound Pattern of English* (Chomsky & Halle 1968) initiated a research program that did not recognize the syllable as a basic concept of the theory. The main argument that was given against incorporating the syllable into the theory has to do with conceptual economy. On the one hand, syllables seem not to be descriptively necessary (see e.g. Kohler 1966[1]). Morpheme-internal syllable boundaries never appear to be contrastive: a given language cannot have two morphemes /ap.la/ and /a.pla/ that differ only in the location of the syllable boundary (Hyman 1975).[2] It follows that syllable boundaries can always be derived by universal and language-specific principles governing segment sequences. Likewise, phonological processes that are expressed with reference to the syllable can always be reformulated in sequential terms. Conceptual economy, that seeks to minimize the set of primitive notions, would therefore argue against the syllable as a basic unit in phonology.[3]

But this line of research was soon challenged by a number of studies, such as Hoard (1971), Hooper (1972), and Vennemann (1972) (in the framework of Natural Generative Phonology), which argued for incorporating the syllable into the theory. Their arguments focus on the explanatory and unifying power of the syllable, and the simplicity of syllable-based accounts (see also van der Hulst & Ritter 1999). It was proposed that the syllable, although it added to the conceptual apparatus of the theory and made representations more complex, allowed for a simplification of the grammar. Syllable-formation rules are stated only once and need not be repeated for all the processes that refer to the syllable, whereas in the SPE approach syllabic

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[1]Note that Kohler (1966) argues that the syllable is not only "unnecessary" but also "impossible" and "harmful".

[2]Barra Gaelic has been viewed as an exception to this generalization; Kenstowicz & Kisseberth (1979) propose that in this language morphemes contain at least some pre-specified syllable structure in their underlying representation. But Clements (1986), followed by, among others, Bosch (1991), Ní Chiosáin (1994) and Smith (1999), has reanalyzed the Barra Gaelic facts without contrastive syllabification.

[3]The argument of conceptual economy is not explicitly expressed in SPE, but was at the heart of Chomsky and Halle's decision to do away with the syllable (Anderson 1985: 347).

contexts were segmentally expressed in each rule. The power of the syllable is forcefully expressed by its "ability to simultaneously generate predictions in three distinct empirical domains: intuitions of string division, rhythmic phenomena like stress and constraints on permissible segment sequences" (Steriade 1999a: 3). Reference to syllable structure thus makes the analysis of certain processes more enlightening. The following quote from Vennemann (1972: 2) illustrates this position well:

> I will advocate here the incorporation of syllable boundaries and syllables in phonological descriptions. I will not say, however, that the incorporation of these concepts into the theory of grammar is "necessary". All phonological processes which can be stated in a general way with the use of syllable boundaries can also be stated without them, simply by including the environments of the syllabification rules in the formula. My contention is rather that in numerous cases such a formulation would miss the point, would obscure the motivation of the process rather than reveal it.

Ultimately, the syllable has secured its place in the theory, and its explanatory potential has been greatly exploited in the last decades, particularly within what has been called Prosodic Phonology. A survey article on the syllable in phonological theory can then safely conclude that "the role of the syllable in phonological theory has become more significant with each passing decade" (Blevins 1995: 206), phonological processes being now typically accounted for with reference to syllabic structure.

The most basic principle of Prosodic Phonology is that of Prosodic Licensing, given in (1) in Itô's (1986: 2) formulation:

(1)    PROSODIC LICENSING:
       All phonological units must be prosodically licensed, i.e., belong to higher prosodic structure (modulo extraprosodicity).

The phonological units I am concerned with are segments, the higher prosodic structure to which they must belong is the syllable. Segments – and the features that compose them – must be incorporated into syllables to surface. In other words, strings of segments must be exhaustively syllabified. Processes such as consonant deletion have been proposed to fall out directly from Prosodic Licensing through the general convention of Stray Erasure (Steriade 1982; Itô 1986, 1989), which automatically deletes at the end of a cycle consonants that cannot be included into

well-formed syllables. Consonant deletion rules can then be eliminated from the grammar. The introduction of universal principles and conventions which allow for the elimination of a number of language-specific rules or constraints has pushed the simplification of the grammar one step further. This unifying approach is attractive, even though its implementation in specific cases may give rise to quite complex adjustments.

To avoid deletion, consonants may be syllabified before the application of Stray Erasure by epenthesis (Stray Epenthesis) or feature-changing rules, which provide an additional nucleus or alter the featural content of the consonant in a way that makes it compatible with the syllable well-formedness conditions. Laryngeal neutralization processes have been typically analyzed in those terms, on the idea that laryngeal features tend to be disallowed in certain syllabic positions, notably the coda (e.g. Rubach 1990; Lombardi 1991, 1995, 1999). I will only focus, however, on deletion and epenthesis processes, a large number of which have been analyzed as motivated by the requirement of exhaustive syllabification.

### 1.1.2. SYLLABLE WELL-FORMEDNESS CONDITIONS

Syllable well-formedness conditions mainly fall into three groups: 1) those that govern the complexity of the different syllabic constituents (nucleus, onset, and coda), 2) those concerned with the specific features that can or cannot be licensed in certain syllabic positions, and 3) those related to the sonority profile of the syllable. The first condition may be expressed by syllable templates, which give the maximal syllable allowed in a language (e.g. Itô 1986).[4] For example, a CVC template indicates that only one consonant may appear in the onset and the coda. In Optimality Theory, the effect of templates is obtained with the appropriate ranking of constraints banning codas (*CODA) and complex syllabic constituents (*COMPLEX). The second condition concerns codas in particular and is expressed in Coda Conditions. For example, the coda position may only license coronals, or it may not license laryngeal features.

The last condition falls under the well-known Sonority Sequencing Generalization or Sonority Sequencing Principle (SSP), which can be expressed as follows (Hankamer & Aissen 1974; Hooper 1976; Steriade 1982; Selkirk 1984; Clements 1990, among others; see in particular Clements for an interesting

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[4]There has been a debate over whether syllables are built through syllable templates (e.g. Itô 1986) or syllabification rules (e.g. Steriade 1982; Levin 1985). This distinction is not crucial here and my use of templates follows from their being easier to manipulate. See Blevins (1995) and Rubach (1999) – who both argue for the rule-based approach – for recent overviews of this issue.

discussion of this principle, and Cser (2000) for a useful review of the various phonological approaches to sonority):

(2)     SEQUENCING SONORITY PRINCIPLE:
         Sonority must not increase from the nucleus to the edges of the syllable.

The sonority hierarchy of the different segments has been debated for more than a century (Whitney 1865; Sievers 1881; Jespersen 1904; Saussure 1916; see Ohala 1992 for older references and Rubach 1999 for discussion). Among consonants, the simplest hierarchy would distinguish between sonorants and obstruents (Zec 1995). At the other extreme, numerous fine distinctions can be made within obstruents and sonorants, based on manner of articulation, voicing, or place. The SSP is not a main concern of this dissertation, nor are the precise hierarchy and the range of possible language-specific variations that one should adopt. The data I examine that are accounted for by the SSP are perfectly compatible, and in some respects support, Clements's simple hierarchy in (3), which I will use throughout the dissertation:

(3)     CLEMENTS'S (1990) SONORITY HIERARCHY:
         vowels > glides > liquids > nasals > obstruents
          (x > y: x is more sonorous than y)

When one of the well-formedness conditions is violated, the available repair strategies mainly include deletion (stray erasure), epenthesis (stray epenthesis), and feature-changing processes. Other strategies may be sporadically used (metathesis, the use of syllabic consonants). In addition, well-formedness conditions may serve to block the application of certain processes which are expected otherwise. For instance, vowel syncope or apocope may fail to apply when the resulting string could not be parsed into well-formed syllables. I restrict my attention here to consonant deletion, vowel epenthesis, and vowel deletion. All possible associations of a condition and a process (used to repair a violation or blocked to avoid one) are attested. The following table gives one representative example found in languages of the world. Relevant data and references follow.

Table 1:
**Deletion and epenthesis processes triggered
by syllable well-formedness conditions**

| PRINCIPLES→ PROCESSES↓ | Template | Coda Conditions | SSP |
|---|---|---|---|
| C deletion | Korean | Lardil | Québec French |
| V epenthesis | Cairene Arabic | Selayarese | Chaha |
| V deletion blocked | Tonkawa | Kuuku-Ya'u | Gallo-Romance |

### 1.1.2.1. Syllable templates

The three languages cited in table 1 – Korean, Cairene Arabic, and Tonkawa – can be assumed to have a CVC template. No more than one consonant is allowed in the onset or the coda (I ignore the complexity of the nucleus). Cairene Arabic also allows one additional extrasyllabic consonant phrase-finally.[5]

Korean has a limited number of morphemes that end in a two-consonant cluster underlyingly (K.-O. Kim & Shibatani 1976; Iverson & Lee 1995; S.-H. Kim 1995; Shim 1995 and numerous other references cited in these works). When these morphemes appear before a vowel, the last consonant resyllabifies in the following onset; otherwise, one of the two consonants deletes to conform to the CVC template. This is shown in (4) below (data from S.-H. Kim 1995).

(4)     CONSONANT DELETION IN KOREAN:
        a.        /kaps+to/      →    [kap.t'o]       'price-ADJUNCTIVE'
                  /kaps/          →    [kap]            'price'
            vs.   /kaps+e/       →    [kap.s'e]       'price-LOCATIVE'
        b.        /salm+to/      →    [sam.to]        'life-ADJUNCTIVE'
                  /salm/          →    [sam]            'life'
            vs.   /salm+e/       →    [sal.me]        'life-LOCATIVE'

In Cairene Arabic (Broselow 1980, 1992; Selkirk 1981; Wiltshire 1994, 1998), unsyllabifiable consonants that arise through morpheme or word concatenation do not delete but are "saved" by an epenthetic vowel that provides an additional nucleus to which the consonant(s) can attach. An epenthetic [i] (underlined in the examples below) is inserted between the second and third consonant:

(5)     VOWEL EPENTHESIS IN CAIRENE ARABIC:
        a. /katab-t-l-ha/          →    [ka.tab.til.ha]       'I wrote to her'
        b. /katabt gawaab/       →    [ka.tab.ti.ga.waab]  'you (m.) wrote a letter'
        c. /bint nabiiha/          →    [bin.ti.na.bii.ha]    'an intelligent girl'

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[5]Other processes analyzed as triggered by syllable templates include: 1. consonant deletion: Menomini (CVC) (Y.-S. Kim 1984), Kamaiurá (CV) (Everett & Seki 1985; McCarthy & Prince 1993); vowel epenthesis: Chukchi (CVC) (Kenstowicz 1994b), Lenakel (CVC) (Lynch 1978; Blevins 1995; Kager 1999); vowel deletion: South-eastern Tepehuan (CVC) (E. Willet 1982; T. Willet 1991; Kager 1997). Turkish displays both consonant deletion (degemination) and vowel epenthesis (CVC) (Clements & Keyser 1983).

Tonkawa has a very productive process of internal vowel syncope, in addition to a process of final vowel deletion, which I disregard here (Hoijer 1946; Kisseberth 1970; Phelps 1973, 1975; Noske 1993). Ignoring morphological constraints on syncope (only non-final vowels in the stem may delete), this process appplies as often as possible, provided the resulting string can be parsed into well-formed CVC syllables. It is blocked when it would result in an unsyllabifiable sequence of consonants. This is illustrated in (6).

(6)    SYNCOPE IN TONKAWA:
       a. /picena+n+oʔ/        →        [picnanoʔ]        'he is cutting it'
       b. /we+picena+n+oʔ/     →        [wepcenanoʔ]      'he is cutting them'

In the form in (6a), only the second vowel of the stem may be dropped. If the first were to delete, we would get an initial [pc...] cluster that cannot be parsed since complex onsets are disallowed according to the CVC template of Tonkawa. In (6b), the presence of the vowel-final prefix allows the first vowel of the stem to delete. But then the second one must stay to prevent the unsyllabifiable three-consonant sequence [pcn]. (I ignore here why it is the first rather than the second vowel of the stem that deletes in (6b)).

### 1.1.2.2. Coda Conditions

Coda conditions are extremely varied and deal with a great number of distinct features. Cross-linguistically, consonant deletion, vowel epenthesis, and vowel deletion seem to be triggered or blocked by constraints on manner and place features, with laryngeal features playing only a secondary role.[6] The examples presented here involve place features.[7]

Lardil (K. Hale 1973; Klokeid 1976; Itô 1986; Wilkinson 1988) and Kuuku-Ya'u (Thompson 1988) do not allow non-coronal consonants in coda position (with the exception of nasals homorganic with the following onset). Kuuku-Ya'u displays

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[6]For example, constraints on voicing alone will not trigger deletion or epenthesis (Steriade 1999d), but they may be involved in conjunction with other features. For instance, voiceless obstruents but not voiced ones delete after nasals, or the other way round (see Archangeli, Moll & Ohno 1998 and Hyman, to appear, for examples of both types).

[7]Examples of deletion and epenthesis triggered by constraints on manner features include Brazilian Portuguese (Olímpio de Magalhães 1999) and Basque (Artiagoitia 1993). In both languages stops are banned from the coda. In Brazilian Portuguese, coda stops are avoided by epenthesis (e.g. seg[i]mento 'segment'; ab[i]negar 'renounce'), in Basque by deletion or epenthesis (see chapter 5).

additional restrictions on morpheme-final consonants, which can only be a member of the set {n,l,j}.

In Lardil, the only context where non-coronal consonants do not appear before a vowel (i.e. in onset position) is word-finally, i.e. when stems ending in a non-coronal consonant are uninflected (7a), or when a non-coronal consonant becomes final after the application of an apocope rule that deletes word-final vowels from stems which are longer than disyllabic (7b). In both cases the final non-coronal consonant deletes since it is banned from the coda position. The examples in (7c-d) show the distinct behavior of coronal consonants, which are retained in the output.

(7)    NON-CORONAL CONSONANT DELETION IN LARDIL:
       | | UR | Apocope | Non-cor deletion | SR | |
       |---|---|---|---|---|---|
       | a. | /ŋaluk/ → | n/a | ŋalu | [ŋalu] | 'story' |
       | b. | /puṭuka/→ | puṭuk | puṭu | [puṭu] | 'short' |
       | c. | /jaɽput/ → | n/a | n/a | [jaɽput] | 'snake, bird' |
       | d. | /jalulu/ → | jalul | n/a | [jalul] | 'flame' |

In Kuuku-Ya'u, an optional process of vowel deletion deletes morpheme-final vowels. However, this process applies only when the preceding consonant is one of the permissible mopheme-final coronal consonant {n,l,j}. Otherwise, syncope and apocope fail to apply to avoid a violation of the coda condition against non-coronal consonants. Vowels that may not delete are underlined.

(8)    VOWEL DELETION IN KUUKU-YA'U
       a. /ṭaʔi-na/            →        [ṭaʔin]           'hit-NONFUTURE'
       b. /ŋaŋkala/            →        [ŋaŋkal]          'give-IMPERATIVE.SG'
       c. /mukana-pinṭa/       →        [mukanpinta]      'big-COMITATIVE'
       d. /taŋu-la/            →        [taŋul]           'canoe-POSITIONAL'

Selayarese (Broselow 1999) allows only glottal stops, nasals, and first parts of geminates in coda position. Word-internally, nasals are always homorganic with the following onset; word-finally, they surface as a velar nasal [ŋ]. Complex onsets are banned altogether. This is a cross-linguistically familiar pattern. Words borrowed from Bahasa Indonesia often contain codas or complex onsets that are illegal in Selayarese. In some cases, the unsyllabifiable consonant is transformed into a legal coda; for example, word-final stops become glottal stops. Otherwise, a copy vowel is inserted that turns the illegal consonant into an onset.

(9)     VOWEL EPENTHESIS IN SELAYARESE:
        Bahasa Indonesia              Selayarese
        a. arus                       [arus<u>u</u>]            'current'
        b. kikir                      [kikir<u>i</u>]           'metal file'
        c. bakri                      [bak<u>a</u>ri]           'interpretation'

We can interpret the Selayarese data in terms of a constraint against place features in coda.[9] Assuming that glottal stops and velar nasals are placeless (e.g. Trigo 1988; Paradis & Prunet 1993), we see that the only consonants that are tolerated in the language are either placeless or homorganic with the following onset. The data straightforwardly follow from the fact that codas are unable to license place features.

### 1.1.2.3. The Sonority Sequencing Principle

The SSP requires sonority to fall from the nucleus to both edges of the syllable. In Gallo-Romance (Pope 1961; Jacobs 1989), final vowels other than /a/ were reduced to /ə/ and subsequently lost between the 7th and the 9th century. However, this apocope process was blocked when it would have resulted in a final cluster that did not obey the SSP. The contrast between (10a-b) and (10c-d) illustrates the role of the SSP. A final schwa preceded by a single consonant (10a) or a cluster of falling sonority ([rt] in (10b)) deletes, as shown by the vowel-less Old French form. But the final schwa was retained after a cluster of rising sonority (obstruent-liquid in (10c) or obstruent-nasal in (10d)), and was still present in Old French (which also illustrates other processes: cluster simplification and consonant epenthesis).

(10)    APOCOPE IN GALLO-ROMANCE:
        Reconstructed                 Old French
        Gallo-Romance
        after vowel reduction
        a. *nɛtə            >    net            'clean, clear'
        b. *fɔrtə           >    fort           'strong'
        c. *pɛðrə           >    pere           'father'
        d. *simlətudnə      >    sembletune     'resemblance'

Eventually, all final vowels were lost in the history of French, so that the modern language has a large number of words ending in clusters that violate the SSP. The spoken language, however, displays a strong tendency to simplify those clusters by deleting the last consonant. This processs is illustrated with data from Québec French:

(11)    FINAL CONSONANT DELETION IN QUÉBEC FRENCH:
        a. *poutre*      /putr/      →    [put]       'beam'
        b. *catéchisme*  /kateʃism/  →    [kateʃis]   'catechism'

Chaha (Rose 1997b, to appear) also has a number of underlying forms ending in bad sequences of consonants according to the SSP. The only CC clusters that are allowed to surface word-finally in this language are those in which sonority falls (12a-b).[8] Otherwise an epenthetic vowel is inserted between the consonants (12c-d).[9]

(12)    VOWEL EPENTHESIS IN CHAHA:
        a. /srt/    →    [sɨrt]       'cauterize!'
        b. /kft/    →    [kɨft]       'open!'
        c. /dβr/    →    [diβɨr]      'add!'
        d. /rk'm/   →    [nɨk'ɨm]     'pick!'

### 1.2. THE SYLLABIC APPROACH: WEAKNESSES

Although the syllabic approach adequately accounts for the above cases, I argue in this section that deletion and epenthesis patterns should not be treated with reference to syllable structure. The following points can be brought in support of this conclusion:

(13)    WEAKNESSES OF THE SYLLABIC APPRAOCH:
        a. *The syllabic approach is insufficient:*
        - Epenthesis and deletion often fail to apply in contexts where syllable well-formedness predicts them to be applicable.
        - Epenthesis and deletion often apply in contexts where syllable well-formedness does not predict them to be applicable.
        b. *The syllabic approach is inadequate:*
        Upon closer examination, the syllabic account cannot be maintained for several of the cases of epenthesis and deletion for which it has been proposed.
        c. *The syllabic approach is unnecessary:*
        For the patterns that are naturally compatible with a syllabic analysis, an equally simple sequential account that makes no use of syllable well-formedness conditions is easily available.

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[8]We observe variation in whether epenthesis applies in sonorant-sonorant clusters and obstruent-obstruent ones other than fricative-stop (12b). See Rose (to appear) for discussion.

[9]Among other languages that use epenthesis to avoid violating the SSP: Itelmen (Bobaljik 1997), Romansch (Montreuil 1999), Khalkha Mongolian (Svantesson 1995; Harada 1999).

I will present in more detail each of these points. The bulk of the discussion will focus on (13b), which I treat last: We will review a number of deletion and epenthesis patterns that have been accounted for in syllabic terms and show how these analyses are empirically inadequate. Interestingly, the inadequacy of the prosodic approach in consonant phonotactics has been brought to attention for processes other than deletion and epenthesis. This critical view has been expressed in e.g. Lamontagne (1993) for English consonant sequences, and Blevins (1999). But a more articulated version of it is the one developed by Steriade (1999a, c, to appear), who argues for a sequential account of laryngeal and place neutralization processes, in a phonetically-based Optimality framework that is refered to as 'Licensing by Cue' (as opposed to 'Licensing by Prosody'). This approach, which will be presented in chapter 3, has been supported for palatalization processes by Kochetov (1999).[10] The work presented here can be seen as part of this more general line of research questioning the role of the syllable in phonotactic patterns.

## 1.2.1. IT IS INSUFFICIENT: EXTRASYLLABICITY AND SEQUENTIAL CONSTRAINTS

It is well-known that epenthesis and deletion may behave in ways that are unexpected given syllable well-formedness alone. First, consonants may surface even though they cannot be incorporated into well-formed syllables, which is unexpected from the standpoint of prosodic licensing. Two possibilities arise: 1. consonant deletion and vowel epenthesis fail to apply in contexts where they are expected; 2. vowel deletion applies in contexts where it should not. Second, consonants may delete or trigger vowel epenthesis even though they are properly syllabified, or they may block vowel deletion even though the process would not make them unsyllabifiable.

These "exceptions" are not necessarily problematic for the syllabic approach, if independent and well constrained principles that interact with syllable well-formedness conditions can account for them. The implicit assumption so far has been that such principles exist. On the one hand, a device of extrasyllabicity[11] has been proposed and incorporated into the principle of prosodic licensing to allow certain

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[10]Gess (1999), looking at patterns of assimilation in sequences of two nasal consonants, extends Jun's (1995) cue-based, but also syllable-based, approach into a purely sequential model similar to Steriade's.

[11]The terms extrametricality and extraprosodicity are also often used. I prefer extrasyllabicity, which is the only term that is compatible with the different implementations of this idea (see below). Consonants may be extrasyllabic without being extrametrical or extraprosodic: they may occupy the onset position of an empty-headed syllable, or may attach directly to a constituent higher than the syllable (prosodic word or some phrasal constituent).

consonants to escape the requirement of exhaustive syllabification. Consonants may be marked as extrasyllabic and not be subject to syllable well-formedness conditions. On the other hand, epenthesis and deletion processes may be motivated by constraints and principles that are independent of syllable well-formedness, in particular sequential ones, which apply over sequences of segments without reference to syllable structure.

I argue, however, that extrasyllabicity and sequential constraints are not properly constrained, and may always be called on to explain deletion and epenthesis processes for which a syllabic analysis is not available. This considerably weakens the syllabic licensing approach and makes it in essence unfalsifiable. Extrasyllabicity and sequential constraints are reviewed in turn.

### 1.2.1.1. Extrasyllabicity

Deletion and epenthesis processes are often disrupted at the edges of prosodic constituents, typically the prosodic word. Thus, consonant deletion and vowel epenthesis may apply only domain-internally, but not at the margins, whereas vowel deletion may apply only at edges but not domain-internally. Cairene Arabic provides a case of epenthesis that does not apply phrase-finally. Complex codas and onsets are not allowed phrase-internally, hence epenthesis in the form /katabt gawaab/ → [katabtigawaab] (5b). But final clusters surface intact in phrase-final position: /katabt/ → [katabt]. Lardil (K. Hale 1973) offers an example of vowel deletion that applies only word-finally, but not at word-internal morpheme boundaries. Contrast [karikari-wuɾ] 'butter-fish-FUTURE' with the bare stem [karikar]: the stem-final vowel [i] deletes word-finally but remains before a suffix. See Piggott (1980, 1999) for a similar pattern in Ojibwa.

To account for these "edge effects", it has been proposed that edge consonants may remain extrasyllabic and escape syllable well-formedness conditions and the requirement of exhaustive syllabification. This idea has been implemented in various ways, which differ on how edge consonants are represented and how they are ultimately licensed. The following four approaches may be mentioned[12]:

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[12]I leave aside the OT approach to edge effects proposed by McCarthy & Prince (1993), in which edge effects may be derived without extrasyllabicity / extrametricality, by crucially ranking constraints on syllable well-formedness with alignment constraints between syllables and morphological constituents (e.g. the stem). This approach is possible only in the context of Containment theory, in which edge consonants, even if unparsed, remain present in the representation. It does not carry over in Correspondence theory (McCarthy & Prince 1995), now the standard approach in OT and the one I use in this work.

(14)    APPROACHES TO EXTRASYLLABICITY:

a. *Extrametricality:* Edge consonants are marked as extrametrical for syllabification purposes, and are ultimately licensed by adjoining to a syllable late in the derivation, once syllable well-formedness conditions no longer apply (Borowsky 1986; Itô 1986; Booij 1999).

b. *Final consonants as onsets:* Final consonants are represented as onsets of empty-headed syllables and are not subject to the coda conditions that apply to domain-internal codas. This approach is prominent in Government Phonology (e.g. Kaye 1990); see also Dell (1995) for French.

c. *Indirect licensing*: Edge segments are licensed not by the syllable but by a higher constituent, especially the prosodic word (Piggott 1999; Spaelti 1999; Auger & Steele 1999; Steele & Auger 1999).

d. *Alignment* (Wiltshire 1994, 1998, to appear; Clements 1997): Extrasyllabicity is derived by interactions between constraints on syllable structure and alignment constraints with higher prosodic domains.

Proposed in the context of edge effects, extrasyllabicity has standardly been restricted to margins of prosodic domains, especially the prosodic word. This is the so-called Peripherality Condition. But extrasyllabic consonants have also been postulated domain-internally in certain languages that allow particularly complex consonant sequences, e.g. Polish (Rubach & Booij 1990), Piro (Lin 1997b), Bella Coola (Bagemihl 1991), French (Rialland 1994). This extension of extrasyllabicity to domain-internal contexts is a major move, as it runs the risk of turning extrasyllabicity into an unconstrained mechanism. Extrasyllabicity is an exceptional device that does not follow naturally from the prosodic approach to deletion and epenthesis processes. Since it allows consonants to escape syllable well-formedness conditions, which form the cornerstone of the whole approach, an unrestricted use of it would render the principle of prosodic licensing meaningless. To be a valid principle of segmental phonology, extrasyllabicity has to be strictly constrained, which is presently not clearly the case.

One additional argument in favor of extrasyllabicity is the fact that certain consonants, especially those at edges, often freely violate constraints which normally apply to syllable-affiliated consonants. For example, Blevins (1995: 241) notes that word-initial clusters in Klamath do not obey the Sonority Sequencing Principle. This relative freedom is expected since syllable well-formedness conditions do not apply in this position.[13] But consonants assumed to be extrasyllabic may not always be so unconstrained. They are highly restricted in other languages. Dutch, for example,

allows only coronal obstruents in final position, and /s/ in initial position to be extrasyllabic (Booij 1999). While the coronality of these segments may follow from markedness considerations, what about the restriction to obstruents? I suggest that it is motivated by the desire to avoid violations of the SSP (assuming, as in the hierarchy in (3), that fricatives and stops are equal in sonority). But this result cannot follow from extrasyllabicity, since extrasyllabic consonants do not count in the evaluation of sonority.

### 1.2.1.2. Sequential constraints

The development of prosodic analyses has not removed the need for purely sequential rules and constraints, which apply over sequences of segments irrespective of their prosodic affiliation. This has been recognized by proponents of the prosodic approach, for example Itô (1986: 45), who states that "certain intersyllabic melody constraints are only made unenlightening by reference to syllabic structure". It is therefore not unexpected that epenthesis and deletion patterns may be motivated by sequential principles that are independent of the syllable. See for example Broselow (1982) for vowel epenthesis.[14]

The most widely accepted sequential principle is certainly the Obligatory Contour Principle (OCP), which prohibits identical adjacent segments on a given tier. Proposed by Leben (1973) and Goldsmith (1976) to account for tonal phenomena, it was first extended to segmental processes by McCarthy (1986), Odden (1988), and Yip (1988).[15] A large number of segmental processes have subsequently been argued to fall under the scope of the OCP. The following table provides examples for consonant deletion, vowel epenthesis, and vowel deletion.

Table 2:
**Examples of deletion and epenthesis processes triggered by the OCP**

| PRINCIPLE→<br>PROCESSES↓ | OCP |
|---|---|
| *C deletion* | Catalan |
| *V epenthesis* | English |
| *V deletion blocked* | Afar |

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[13]Thus, Itô (1986: 174) rejects the hypothesis that the obstruent in certain word-initial obstruent-liquid clusters is extrasyllabic, for the reason that these clusters obey the sonority requirement.

[14]It must be noted, however, that consonant deletion is one process for which it has been hypothesized that all instances of it follow from Stray Erasure (Steriade 1982; Itô 1986). The existence of consonant deletion patterns that are incompatible with a syllabic analysis therefore shows that such a hypothesis cannot be maintained. Empirical support for this conclusion will be amply given in section 1.2.3; see also Kenstowicz (1994a: 288-291) for discussion of other challenges to Stray Erasure.

[15]See Myers (1997) and Suzuki (1998) for discussions of the OCP within Optimality Theory.

Catalan has a productive process of word-final stop deletion, which applies only if the stop follows a homorganic consonant (Mascaró 1983, 1989; Bonet 1986; Wheeler 1986, 1987; Morales 1995; Herrick 1999). Contrast the examples in (16), in which the stop and the preceding consonant differ in place or articulation, with those in (15), in which the two consonants are homorganic. Only in the first set does deletion apply. This pattern could be analyzed in terms of an OCP constraint on place of articulation: the final stop deletes to avoid sequences of homorganic consonants.[16],[17]

(15)   DELETION IN HOMORGANIC CLUSTERS IN CATALAN:
   a.   /-rt/:   fort   'strong'   /fort/   →   [for]
   b.   /-lt/:   alt   'tall'   /alt/   →   [al]
   c.   /-nt/:   punt   'point'   /puNt/   →   [pun]
   d.   /-mp/:   camp   'field'   /kaNp/   →   [kam]
   e.   /-ŋk/:   bank   'bank'   /baNk/   →   [baŋ]
   f.   /-st/:   bast   'vulgar'   /bast/   →   [bas]

(16)   NO DELETION IN NON-HOMORGANIC CLUSTERS IN CATALAN:
   a.   /-lp/:   balb   'numb'   /balp/   →   [balp] * [bal]
   b.   /-lk/:   calc   'calque'   /kalk/   →   [kalk] * [kal]
   c.   /-rp/:   herb   'herb'   /erp/   →   [erp] * [er]
   d.   /-rk/:   arc   'arc'   /ark/   →   [arc] * [ar]
   e.   /-sp/:   Casp   (a town)   /kasp/   →   [kasp] * [kas]
   f.   /-sk/:   fosc   'dark'   /fosk/   →   [fosk] * [fos]

(Morales 1995)

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[16]An OCP-place constraint cannot be the whole story, as homorganic clusters in which the final consonant is not a stop surface intact (e.g. pots 'you can' [pots]). Morales's (1995) solution to this is based on Radical Underspecification and the assumption that stops lack manner feature specifications. Also, the constraint against homorganic sequences applies only word-finally; a simple OCP-place constraint does not capture this restriction and needs to have its domain of application restricted. I will provide in the following chapters a different account of the Catalan case and the special status of stops in deletion patterns more generally.

[17]Other cases of deletion motivated by the OCP include Korean /y/-deletion after (alveo-)palatal consonants (H.-S. Kang 1998) and /r/-deletion in Vinzelles Occitan (Elordieta & Franco 1995; see also Morin 1982; Dauzat 1897, 1900). Stop deletion in Baztan Basque is also standardly analyzed as a case of OCP on the continuancy tier, as it is said that stops delete and affricates simplify only before [-continuant] segments (Salaburu 1984; Lombardi 1990; Hualde 1991; H. Kim 1997; Fukazawa 1999). We will see however in chapter 5 that the OCP is clearly not the correct motivation for this process in all the other Basque dialects I have looked at, and that the case for the Baztan variety is unclear.

A classic case of epenthesis is found in the suffixation of -ed and -s in English. When these suffixes are added to stems ending in a dental stop and a coronal fricative or affricate, respectively, an epenthetic vowel is inserted between the two morphemes. Hence cheated [tʃitəd] and passes [pæsəz]. A similar example is found in Hebrew (Kenstowicz 1994a: 533).

Afar (McCarthy 1986, based on Bliese 1981), an East Cushitic language, illustrates how vowel deletion can be blocked by the OCP. This language has a syncope rule that deletes an unstressed vowel in a peninitial two-sided open syllable. This rule, however, systematically fails to apply when the consonants on both sides of the potential deletion site are identical. Contrast the first two examples below with (17c) and (17d), where the second vowel is flanked by two /r/'s and two /n/'s, respectively.

(17)   SYNCOPE IN AFAR:
   a.   digib+e   →   [digbe]   'she/I married'
   b.   meʕer+a   →   [meʕra]   'you/he kills a calf'
vs.   c.   xarar+e   →   [xarare]   'he burned'
   d.   gonan+a   →   [gonana]   'he searched for'

The OCP may motivate a large number of deletion and epenthesis processes that do not appear to be syllabically-conditioned. But there remains a substantial residue of cases that can be accounted for neither with syllable well-formedness conditions nor with the OCP. Process- or language-specific sequential rules and constraints are then usually postulated, without there being general principles that govern them. Analyses based on such rules and contraints often have a highly descriptive and ad hoc flavor, and they tend to be used as a fall-back option when a more principled analysis, in particular a prosodic one, does not seem available. This is not meant as an argument against sequential constraints in general but it does represent a weakening of the prosodic approach.

Such sequential constraints, proposed to account for deletion or epenthesis phenomena, show all levels of generality or specificity. Very general ones include *CC or *CCC, which ban sequences of two or three consonants, irrespective of their syllabic affiliation. For example, Archangeli, Moll & Ohno (1998) and Archangeli & Ohno (1999) use *CC in their analysis of the resolution of nasal-consonant (NC) sequences in various languages. These clusters are found in different prosodic positions and often trigger deletion of one of the consonants. Lin (1997b) proposes a constraint *CCC to account for the blocking of vowel deletion in Piro when deletion would yield a three-consonant sequence.

Constraints that deal with more specific sequences of consonants are also needed. For instance, the constraint *RG, which bans sequences of a sonorant consonant followed by a voiced obstruent, was proposed by Ní Chiosáin (1996, 1999; see also Green 1997). This constraint accounts for cases of vowel epenthesis in Irish and Gaelic. Smith (1999) uses similar but even more specific constraints in his analysis of related facts in Leurbost Gaelic.

The OCP – or a similar principle against identical adjacent elements in some dimension(s) – appears to be empirically well-motivated, and plays an important role in the analysis of various deletion and epenthesis patterns developed in chapter 4. But the coexistence of syllabic and non-OCP sequential constraints is problematic, because both types of constraints target the same type of configurations, without there being principled arguments for adopting a sequential or a syllabic point of view. Cases of consonant deletion or vowel epenthesis in contexts of consonant clusters are sometimes compatible and sometimes incompatible with a syllabic analysis. Yet, they all share the same basic motivation: avoiding "difficult" sequences of consonants or consonants in a marked position. I do not see a distinguishing factor that could be used to define two categories of processes: sequential and syllable-based. In fact, it seems that syllabic analyses are usually preferred when they are tenable, sequential ones having acquired the status of a fall-back option. This, in effect, makes the syllabic approach unfalsifiable, as processes that are incompatible with it can be accounted for in sequential terms, without this arguing against syllable well-formedness as a motivation for deletion and epenthesis. On this point, the prosodic licensing theory of segmental processes is not satisfactory.

As an illustration of the tension between syllabic and sequential constraints used to prevent nearly identical configurations, consider vowel deletion in Tonkawa, Piro, and South-eastern Tepehuan. As mentioned above, vowel syncope in Tonkawa may be said to apply whenever the resulting string can be parsed into well-formed CVC syllables (ignoring independent morphological constraints). It is blocked when it would result in an unsyllabifiable sequence of consonants. Word-internally, this means that deletion does not apply when it results in a sequence of three consonants. Two-consonant clusters are acceptable since they can be parsed as a coda-onset sequence. Examples are repeated below.

(6)     SYNCOPE IN TONKAWA:
        a. /picena+n+oʔ/        →        [picnanoʔ]        'he is cutting it'
        b. /we+picena+n+oʔ/     →        [wepcenanoʔ]      'he is cutting them'

Exactly the same situation holds in South-eastern Tepehuan (Kager 1997, based on E. Willet 1982; T. Willet 1991). Syncope and apocope are both blocked in this language when the resulting string would not conform to the CVC maximal template. Compare (18a) with (18b):

(18)    VOWEL DELETION IN SOUTH-EASTERN TEPEHUAN:
        a. /tɨroviɲ/        →        [tɨrviɲ]                    'rope'
        b. /ka-karvaʃ/      →        [kakarvaʃ] *[kakrvaʃ]       'goats'

Vowel deletion in Piro is subject to exactly the same constraint against sequences of three consonants (Matteson 1965; Lin 1997a,b). It applies (cyclically) to morpheme-final vowels provided a three-consonant cluster is not created.[18] Representative examples follow (from Lin 1997a,b), where deleted vowels are indicated by an underlined gap.

(19)    VOWEL DELETION IN PIRO:
        a. /nika+ya+waka+lu/            →        [nik‗yawak‗lu]
           to eat+LOC+place+it
           'to eat it there'
        b. /n+yo+hlo+ta+kaka+lu/        →        [nyohlot‗kak‗lu]
           I+use an instrument+within+verb suffix+causative+him
           'I cause him to spear (something)'

On the basis of these data, the first analysis of Piro that comes to mind is the one offered for Tonkawa and Tepehuan: Piro has a CVC syllable template, with special conditions applying at word edges. More than one consonant may occur word-initially, a fact consistent with extrasyllabicity, and no consonants are permitted word-finally. Such generalizations are not exceptional cross-linguistically. But Lin (1997b) argues that this solution cannot hold. First, three-consonant clusters do occur word-internally (they involve the suffix /m/, the only monoconsonantal suffix in Piro). Such clusters are incompatible with an (inviolable) CVC template.[19] Second, both Matteson (1965) and Lin (1997a,b) argue against the existence of coda consonants in the language, for distributional and phonetic reasons. First, Piro words never end in a consonant, but they may begin in sequences of up to three

[18]Certain morphemes are arbitrarily marked as blocking the deletion of the preceding morpheme-final vowel. Fricative clusters are also special; unexpectedly, vowel deletion applies in sequences FFV+C (where F=fricative). The resulting three-consonant cluster FFC, however, does not surface, but is repaired by deletion of the first fricative with compensatory lengthening of the preceding vowel. These exceptions and the behavior of deletion and compensatory lengthening need not concern us here.
[19]But the idea of a violable syllable template is not problematic in a framework like OT.

consonants. Second, all non-prevocalic consonants surface "either as a syllabic consonant or has to be followed by a very short epenthetic vowel" (Lin 1997b: 405), properties that are considered uncharacteristic of coda consonants.[20] Lin and Matteson differ, however, on the alternative template they propose: CCCV for Matteson, CV for Lin, with extrasyllabic consonants appearing between syllables and licensed by the mora. Arguments for positing these templates need not concern us here; what is crucial is that both force the use of a sequential constraint of the type *CCC to account for the blocking of vowel syncope.[21]

We see that syncope in Tonkawa, North-eastern Tepehuan, and Piro is subject to the same descriptive constraint, that of avoiding sequences of three consonants word-internally. But only Tonkawa and Tepehuan seem to be amenable to an analysis in terms of syllable templates.[22] Is there a principled reason for adopting two radically different analyses – sequential and syllabic – for what appears to be manifestations of the same generalization? I believe not and argue that the tension between the two types of analysis should rather be relieved by eliminating one of them. Since a syllabic analysis is not viable for a number of deletion and epenthesis processes, as we will see in more detail in the following section, we should look for a uniform non-syllabic approach to them. This is the direction I explore in this dissertation, arguing that it yields a more coherent theory. In the case of Tonkawa, Tepehuan, and Piro, I propose that the relevant constraint is that all (word-internal) consonants have to be adjacent to a vowel. We will shortly come back to this generalization.

**1.2.2. IT IS UNNECESSARY: EQUIVALENT SEQUENTIAL ANALYSES**

We have seen that the analysis of deletion and epenthesis patterns generates an undesirable tension between syllabic and sequential accounts. I have suggested that we should seek a unified approach to these processes, which has to be

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[20]Hsin (1999) uses identical arguments to argue for a CCV rather than CVC structure in Tsou. (See Steriade (1999a) for an approach to syllabification that is crucially based on word-edge phonotactics.)

[21]Lin (1997b) first proposes *CCC but later replaces it with a constraint that bans sequences of two adjacent extrasyllabic moras. *CCC is presented as problematic because it counts the number of segments, but it is not clear to me that the proposed alternative is really more satisfactory in this respect. Another solution will be given below.

[22]Landau (1997) discusses a pattern of vowel deletion in Modern Hebrew that also appears not to be driven by syllable well-formedness. Deletion is blocked when it would create a triconsonantal cluster, except when the first consonant is a sibilant fricative. As Landau notes, this process has to do with permissible consonant sequences rather than the complexity of syllabic constituents. The data presented in the paper, however, are too limited to draw clear conclusions about the segmental constraints active in the process.

sequential in nature since processes may resist a syllabic analysis. But would not such a move make us lose the insight and simplicity of syllabic explanations, which are precisely the reasons why they were thought to be superior to the previous linear analyses (see e.g. Vennemann 1972)? In this and the next sections, I argue on the contrary that abandoning syllable well-formedness conditions does not negatively affect accounts of (non-rhythmic) deletion and epenthesis. I review a number of deletion and epenthesis patterns for which an explanation in syllabic terms has been offered, and conclude that reference to the syllable is either undesirable or unnecessary.

For several cases, syllabic analyses are based on incomplete data, and a more thorough investigation reveals that the facts are incompatible with a non-circular definition of well-formed syllables (that is a definition derived from factors that are independent from the deletion / epenthesis process to be analyzed). Not surprisingly, these patterns are among the most complex ones, and I postpone the lengthy discussion of them until the next section. For now, I focus on the remaining cases – those that are adequately accounted for in syllabic terms. These appear to be rather straightforward, and can just as easily be formulated in sequential terms without loss of simplicity and generality. We may then wonder: Why the syllable?

Consider first the following list of languages in which a consonant deletion pattern has been claimed to follow from Stray Erasure of unsyllabified consonants. This corresponds to the list given in Blevins (1995: 223-224), augmented with the five cases in (20d, h-k).[23]

(20)    PATTERNS OF C DELETION CLAIMED TO RESULT FROM STRAY ERASURE:
        a.  Attic Greek
        b.  Diola Fogny

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[23]I have omitted from Blevins's list the analysis of liaison consonants in French (the case of consonant deletion in (20k) is a different one). The non-surfacing of liaison consonants in French has also been analyzed as a consequence of Stray Erasure (Levin 1988; see also Plénat 1987; Bosch 1991). This is a very particular, complex, and controversial case, which is well beyond the scope of this dissertation. It is not clear whether liaison consonants should be treated as deleted in non-liaison contexts or inserted in liaison ones (see Tranel 1995a for a recent summary of some of the issues). Recent research on the acquisition of liaison may support the insertion analysis (Chevrot & Fayol, to appear; Braud & Wauquier-Gravelines 1999). As for the Stray Erasure analysis in particular, it is problematic because it cannot work without 'brute force' stipulations that make widespread use of lexical marking (Plénat 1987; Bosch 1991) or posit final underlying schwas for all words ending in stable consonants (Levin 1988). This last assumption is not new in French phonology (see for example François Dell's work on schwa), but I think, in accordance with Tranel (1981), that it is empirically unjustified (see chapter 2 on the distribution of schwa in French).

    c.   Icelandic
    d.   Hungarian
    e.   Korean (K.-O. Kim & Shibatani 1976)
    f.   Turkish (Clements & Keyser 1983)
    g.   Menomini (Y.-S. Kim 1984)
    h.   Kamaiurá (McCarthy & Prince 1993; Wiltshire, to appear)
    i.   Basque (Artiagoitia 1993)
    j.   Lardil (Wilkinson 1988)
    k.   Québec French (Côté 1997a)
    l.   English (Borowsky 1986)

These languages can be divided into two main groups. The four cases in (20a-d), examined in detail in the next section, appear to be incompatible – or at least clearly problematic – for the Stray Erasure account. For the rest, the syllabic analysis could be maintained, but I argue that an equally simple sequential analysis is available.

Recall from (4) that Korean enforces a strict CVC template or, in an OT terminology, an undominated constraint against complex codas and onsets *COMPLEX. Consonant deletion applies when a consonant cannot fit into this template. But notice that we could equally well characterize the facts by saying that all consonants in Korean must be adjacent to a vowel. A constraint requiring that consonants be adjacent to a vowel would trigger consonant deletion in the same way as *COMPLEX, without referring to syllables.[24] The Menomini case is equivalent (contrast for the stem /mɛtɛmohs-/ 'woman' the plural form [metɛmohsak] with the singular one [metɛmoh]).[25] Degemination in Turkish follows the same logic (Clements & Keyser 1983): a stem-final geminate consonant surfaces before a vowel-initial suffix but degeminates word-finally and before consonant-initial suffixes (contrast for the stem /hiss-/ 'feeling' the accusative form [hissi] with the nominative one [his] and the ablative one [histen]). In Kamaiurá, consonant deletion is motivated by a CV template, rather than a CVC one as in the three cases above, or an undominated constraint against codas *CODA. This restriction can be reformulated in sequential terms: all consonants have to be followed by a vowel.

In Lardil, as seen in (7), non-coronal consonants delete word-finally but surface before a vowel-initial suffix. This has been claimed to follow from a syllable well-formedness condition banning non-coronals from the coda position. Here again, however, the same result would obtain with an equally simple sequential constraint requiring that non-coronals be followed by a vowel. A similar pattern is found in Basque: stem-final stops delete before consonant-initial suffixes but are retained before vowel-initial ones. (Basque differs from Lardil in that extrasyllabic stops are allowed word-finally). A syllable-based analysis straightforwardly derives these facts by assuming that stops cannot be licensed in coda, but stating that stops in Basque want to be followed by a vowel would be equally successful in accounting for the contrast between consonant-initial and vowel-initial suffixes.

Québec French optionally deletes all word-final consonants in $C_1C_2$ clusters in which $C_2$ is more sonorous than $C_1$, given the sonority hierarchy proposed in (3). Examples were given in (11). The process follows straightforwardly from the SSP, which requires sonority to fall within the coda. The SSP, however, can be reformulated independently from syllabic constituents. Suppose each language specifies a set of possible sonority peaks, which corresponds to the set of possible syllabic nuclei. French, for example, allows only vowels as nuclei or sonority peaks. I then propose the following sequential version of the Sonority Sequencing Principle:

(21)    SONORITY SEQUENCING PRINCIPLE (sequential):
        Sonority maxima correspond to possible sonority peaks.

All segments in the string are associated with a certain sonority level. (Local) sonority maxima correspond to segments in the sequence whose sonority value is higher than that of the adjacent segment(s). Consider the three sequences [tun], [tln] and [tr]. In [tun], [u] is a point of maximum sonority because both its adjacent segments are lower in sonority. [u], a vowel, is also a possible sonority peak, so [tun] does not violate the sequential SSP. The case of [tln] is different: [l] is also a sonority maximum, but not a possible peak because it is nonvocalic, in violation of the SSP. Finally, the [r] in a (word-final) sequence [tr] also violates the principle in (21). Therefore both the segmental and syllabic SSP account for final sonorant deletion in Québec French.

The proposed correspondences between syllabic and sequential constraints are summarized below:

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[24]Except at word edges, this constraint is also equivalent to *CCC (see previous section), but does not count consonants, something that has been brought as a criticism againt constraints of this type.

[25]According to Kim (Y.-S. 1984), Menomini actually allows C+glide complex onsets. A sibilant is also exceptionally allowed word-finally after a glottal stop.

(22)    CORRESPONDENCES BETWEEN SYLLABIC AND SEQUENTIAL CONSTRAINTS:

    a.  Korean/Menomini:    *Syllabic*:    *COMPLEX (CVC template)

                              *Sequential*:    Consonants are adjacent to vowels

    b.  Kamaiurá:    *Syllabic*:    *CODA (CV template)

                              *Sequential*:    Consonants are followed by a vowel

    c.  Lardil/Basque:    *Syllabic*:    *F/CODA (coda condition)

                                              (F a feature or combination of features)

                              *Sequential*:    F is followed by a vowel

    d.  Québec French:    *Syllabic*:    Sonority does not increase from the nucleus to the edges of the syllable

                              *Sequential*:    Sonority maxima correspond to possible sonority peaks

Note that I am not claiming that the sequential and syllabic constraints above are empirically equivalent in all respects – they are not. For example, the exclusion of stops from the coda position is perfectly compatible with the existence of stop-liquid complex onsets, but a constraint requiring stops to be followed by a vowel also has the effect of banning stop-liquid sequences.[26] Likewise, a sequence [rmt] does not violate the sequential version of the SSP because [m] is not more sonorous than both [r] and [t], but it may violate the syllabic version, depending on the position of syllable breaks in the sequence. If the sequence is syllabified [r.mt] with a boundary between the first two consonants, we have an onset [mt] that is ill formed from the point of view of the syllabic SSP.[27] But a syllabification [rm.t] is unproblematic, [rm] being a well-formed coda.[28] The crucial point here is that the sequential and syllabic constraints do an equally good job of accounting for the deletion patterns in (20e-j).

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[26]Modern Basque does allow stop-liquid complex onsets. Does this argue against the sequential constraint proposed above to motivate stop deletion before consonant-initial suffixes? I think not, for the following reason. Although complex onsets are found stem-internally, stem-final stops do delete before all liquid-initial suffixes. So whether we use a coda-based or sequential phonotactic constraint to motivate deletion, we need an additional morphologically-based constraint to distinguish between stem-internal and stem-final stops. In each case one can find a well-motivated constraint to derive the desired facts. Hualde (1997) addresses this issue in a syllable-based approach; see chapter 5 for a sequential alternative.

[27]I have not encountered clear cases where a sequence like [rmt] was ruled out by the SSP, which would support the syllabic version of this principle. As we will see in chapter 2 with respect to the French schwa, sequences that violate the stronger sequential version of the SSP are systematically avoided, but those that only violate the milder syllabic SSP are tolerated, and their behavior can be accounted for in terms of principles and generalizations independent from the SSP. This, I believe, argues for the stronger version.

[28]If a sequence violates the sequential SSP, it necessarily also violates the syllabic version, but not vice versa.

The language that remains to be discussed is English. Borowsky (1986) uses coda conditions to account for word-final consonant deletion in nasal-nasal (*condemn* vs. *condemnation*), voiced stop-nasal (*resign* vs. *resignation*), and nasal-voiced stop (*bomb* vs. *bombard*) sequences, as well as /h/-deletion before a (non-word-initial) unstressed vowel (*vehicle*). These are fairly limited cases, which require specific coda conditions against certain combinations of consonants and a constraint against onset /h/, coupled with a rule that resyllabifies /h/ into the coda of a preceding stressed syllable. To the extent that these coda conditions cannot be established independently from the deletion facts themselves, the analysis faces circularity. More constructively, I believe more insightful non-syllabic accounts are available. I refer to Davis (1999) for a critique of Borowsky's account of /h/-deletion and an alternative proposal in which syllable well-formedness plays no role.[29] The cluster simplification cases would fall out naturally from the special status of stops and the approach to contrast I introduce in my analyses of Hungarian, English, Icelandic, and French in the next section, and more fully develop in chapter 4.

This exhausts the list in (20). I conclude that the syllable never appears to be necessary or even useful in analyzing consonant deletion processes. It does not seem to provide any insight into the nature and characteristics of segmental deletion and epenthesis, or allow a more simple analysis. This conclusion is further supported by patterns of vowel deletion and vowel epenthesis. Cases naturally explained under a syllabic approach fall into the categories in (22), while some others are clearly problematic for it (French schwa). I list below cases of vowel deletion or epenthesis that may be argued to follow from the sequential generalizations in (22):

(23)    SEQUENTIAL CONSTRAINTS AND VOWEL DELETION:

    a.  Consonants are adjacent to a vowel (√ CVCCVC, *CVC$\underline{C}$CVC, *#$\underline{C}$CV, *VC$\underline{C}$#): Tonkawa, Tepehuan, Cairene Arabic, Chukchi, Lenakel

    b.  Consonants are followed by a vowel (√ CVCV, *CV$\underline{C}$CV, *#$\underline{C}$CV, *V$\underline{C}$#): Lenakel (optional)

    c.  A feature F is followed by a vowel: Selayarese (F=[place]), Kuuku-Ya'u (F=[coronal])[30]

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[29]Davis does use syllables in his analysis, but only in terms of alignment with the stressed syllable. I believe the analysis could equally refer to feet, as Davis himself mentions, or stressed vowels.

[30]The case of epenthesis in Brazilian Portuguese (Olímpio de Magalhães 1999) mentioned in note 7 is unclear but raises interesting questions. Stops are assumed to be banned from the coda position, but tolerated in complex stop-liquid onsets. I do not know, however, what happens in words like *atlas* and *Atlantico*. If epenthesis does not apply, the relevant generalization would be that vowel insertion occurs between a stop and any [-approximant] segment. If it does, the sequential generalization would be more complex, but it does not necessarily argue for a syllabic approach.

d.  The SSP:

Chaha, Romansch, Mongolian, Gallo-Romance, Itelmen

Those in (23a-b) and, to a lesser extent (23d), will play a central role in the discussions and analyses to follow. Consonants tend to delete or trigger vowel epenthesis when they are not adjacent to a vowel. Certain languages obey even stricter requirements and demand that consonants be specifically followed by a vowel; likewise, vowel deletion tends to be blocked when this would leave a consonant that is not adjacent to or followed by a vowel. This generalization forms the basis or cornerstone of the analysis to be developed in the rest of the dissertation. For that reason and in order to faciliate reference to it, I present it in the shaded box below:

*Generalization 1:*     Consonants want to be adjacent to a vowel, and preferably followed by a vowel.

Additional generalizations will be presented in the following section. All are refinements, more specific instances of this generalization, which identify consonants that need more than others to be adjacent to or followed by a vowel. The SSP, though not itself the focus of this research, will interact in numerous occasions with the proposed generalizations. I repeat it below. It is this sequential definition that I use hereafter whenever I refer to the SSP.

*Sonority Sequencing Principle:*     Sonority maxima correspond to sonority peaks.

[tl] sequences are indeed standardly assumed to form illegal onsets, [tl] not being an attested word-initial cluster. Internal [tl] are then heterosyllabic and epenthesis is expected. But note that internal heterosyllabicity is not a necessary corequisite of the absence of [tl] initially. The words *atlas* and *Atlantic* are clearly syllabified with coda [t]'s in English, but not in Québec French, even though [tl] is not attested word-initially in either language. I asked two speakers of Québec French to syllabify *atlas* and *Atlantique*; both spontaneously indicated [a.tlas] and [a.tlɑ̃.tik]. One wonders then how speakers of English and Québec French can converge on different syllabic statuses for [tl] in the face of almost identical phonotactics. It could be that they actually use phonetic characteristics of consonants in different positions (e.g. English glottalization) to determine the syllabification, in which case syllabification cannot "precede" the application of segmental processes. On the other hand, the marked status of /tl/ and /dl/ sequences and their distinct behavior from other stop+liquid clusters certainly have a phonetic basis, which has to uncovered. I suspect it has to do with the weakness of coronal stops in preconsonantal position (see discussion of the Attic Greek case later in this chapter and chapter 3 for perceptual motivations). We may get the contrast between /r/ and /l/ after /t,d/ if we accept that /r/ is more sonorous – more "vowel-like" – than /l/. The quality of the stop release burst might also be involved. It is plausible that the burst of alveolar stops is weakened before /l/ because only the lateral constriction of the stop may be released into the /l/, the central one being maintained since it is also involved in the production of the following lateral. More phonetic work is required here.

To conclude, I have argued that syllable well-formedness conditions are unnecessary in accounting for deletion and epenthesis. Were they only unnecessary, we could still have good reasons to use them, in particular if they allowed a unified approach to various segmental and rhythmic processes. But the syllable is not only unnecessary, it is in several contexts clearly inadequate. This is my main argument for seeking an alternative approach to deletion and epenthesis, discussed at length in the coming section.

**1.2.3. IT IS INADEQUATE: A REVIEW OF SOME SYLLABIC ANALYSES**

This section is devoted to patterns I believe are problematic for the syllabic approach. These include consonant deletion in Hungarian, Attic Greek, English, and Icelandic. Vowel deletion and epenthesis in French will be treated in the next chapter. Discussing these cases also allows me to present some empirical generalizations which will be the focus of the following chapters, and which have gone unnoticed or remained mysterious under a syllabic approach. They are constraints that condition the application of consonant deletion, vowel deletion, and vowel epenthesis:

*Generalization 2:*     Stops want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 3:*     Stops that are not followed by a [+continuant] segment want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 4:*     Consonants that are relatively similar to a neighboring segment, want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 5:*     Consonants that are not at the edge of a prosodic domain want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 6:*     Coronal stops want to be followed by a vowel.

Hungarian establishes generalizations 2-5; Attic Greek focuses on 6. Generalizations 2-5 are further supported in the remaining cases, and will come back in full force in the discussion of the French schwa.

**1.2.3.1. Hungarian cluster simplification and degemination**

Hungarian has an optional process of cluster simplification in internal position (Dressler & Siptár 1989; Siptár 1991; Ács & Siptár 1994; Törkenczy & Siptár 1999; Siptár & Törkenczy 2000). This process applies to a subset of sequences of three or more consonants, and always deletes a medial consonant. Dressler & Siptár (1989),

Siptár (1991), and Ács & Siptár (1994) suggest that the process is syllabically-driven. More specifically, it is claimed to depend on whether the last two consonants can form a permissible onset. This would account for the contrast between (24), where simplification is possible, and (25), where it is not. All data come from Törkenczy & Siptár (1999) and Siptár & Törkenczy (2000) and appear in their Hungarian spelling, together with the IPA transcription.[31]

(24)    CLUSTER SIMPLIFICATION IN HUNGARIAN:

|  |  | No simplification | Simplification |  |
|---|---|---|---|---|
| a. | *lambda* | [lɔmbdɔ] | [lɔmdɔ] | 'lambda' |
| b. | *asztma* | [ɔstmɔ] | [ɔsmɔ] | 'asthma' |
| c. | *röntgen* | [røndgɛn] | [røŋgen] | 'X-ray' |
| d. | *dombtető* | [dromptɛtø:] | [domtɛtø:] | 'hilltop' |

(25)    CLUSTER RETENTION IN HUNGARIAN:

|  |  |  |  |  |
|---|---|---|---|---|
| a. | *ámbra* | [a:mbrɔ] | *[a:mrɔ] | 'ambergris' |
| b. | *eszpresszó* | [ɛspres:o:] | *[ɛsres:o:] | 'espresso' |
| c. | *centrum* | [tˢɛntrum] | *[tˢɛnrum] | 'center' |
| d. | *templom* | [tɛmplom] | *[tɛmlom] | 'church' |

The contrast between (24) and (25) derives from the following three assumptions: 1. Complex codas are disallowed (at least word-internally); 2. Consonantal nuclei are not tolerated; 3. Only the most unmarked complex onsets are permitted. From these assumptions it follows that in three-consonant sequences such as those above, the only possible syllabification is [C₁. C₂C₃]; [C₁C₂. C₃] is excluded by the constraint against complex codas and [C₁. C₂. C₃] by that against consonantal nuclei. So the fate of the clusters in (24)-(25) depends on the well-formedness of C₂C₃ as complex onsets. The last two members of the clusters in (25) form stop-liquid sequences that constitute typical complex onsets cross-linguistically. These sequences appear in word-initial position as well in Hungarian (26). It is then suggested that they can form complex onsets, which explains the stability of the medial clusters in (25), correctly syllabified [C₁. C₂C₃], for example [m.br] in (25a). On the other hand, the last two segments in the clusters of (24) – [bd], [tm], [dg], [pt] – are much more marked as complex onsets and do not appear in word-initial

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[31]The examples presented here mostly involve word-internal clusters, but simplification is also possible in compounds (i) and across word boundaries (ii).

|  |  |  | No simplification | Simplification |  |
|---|---|---|---|---|---|
| (i) | a. | *lombkorona* | [lompkoronɔ] | [lomkoronɔ] | 'foliage of a tree' |
|  | b. | *testnevelés* | [tɛʃtnɛvɛle:ʃ] | [tɛʃnɛvɛle:ʃ] | 'PE' |
| (ii) | a. | *dobd ki* | [doptki] | [dopki] | 'throw (it) out' |
|  | b. | *most pedig* | [moʃtpɛdig] | [moʃpɛdig] | 'and now' |

position (Siptár 1980; Olsson 1992). If it is assumed that these sequences are ill-formed as onsets in Hungarian, no possible syllabification is available for the clusters in (24) and the deletion of the medial segment then just follows from Stray Erasure.

(26)    WORD-INITIAL STOP-LIQUID SEQUENCES:

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| a. | *bronz* | 'bronze' | b. | *prém* | 'fur' |
| c. | *tréfa* | 'joke' | d. | *pléh* | 'sheet-metal' |

However, Törkenczy & Siptár (1999) and Siptár & Törkenczy (2000) convincingly show that this syllabic approach to cluster simplification cannot hold. Numerous clusters do not simplify, even though the last two segments should not be considered better-formed onsets than those in (24). Consider the data in (27).

(27)    NO DELETION IN C₁C₂C₃ CLUSTERS WHERE C₂C₃ IS NOT A POSSIBLE ONSET:

|  |  |  |  |  |
|---|---|---|---|---|
| a. | *aktfotó* | [ɔktfoto:] | *[ɔkfoto:] | 'nude photograph' |
| b. | *hangsor* | [hɔŋkʃor] | *[hɔŋʃor] | 'sound sequence' |
| c. | *handlé* | [hɔndle:] | *[hɔnle:] | 'second-hand dealer' |
| d. | *bazaltkő* | [bɔzɔltkø:] | *[bɔzɔlkø:] | 'basalt stone' |
| e. | *szerbtől* | [sɛrptø:l] | *[sɛrtø:l] | 'from (a) Serb' |
| f. | *sejtmag* | [ʃɛjtmɔg] | *[ʃɛjmɔg] | 'cell nucleus' |
| g. | *szenvtelen* | [sɛnftɛlɛn] | *[sɛntɛlɛn] | 'indifferent' |
| h. | *narancsból* | [nɔrɔndʒbo:l] | *[nɔrɔnbo:l] | 'from (an) orange' |

None of the final two consonants in the underlined sequences in (27) appears in initial position in Hungarian, and all are rather marked crosslinguistically as complex onsets. In fact, the last two consonants are in some cases identical or almost identical to those found in (24). See [tm] in (27f) and (24b), [pt]/[bd] in (27e), (24d) and (24a), [tk]/[dg] in (27d) and (24c). Yet consonant deletion occurs in the examples in (24) but not in those in (27). Therefore, simplification cannot be related to the well-formedness as onsets of the last two consonants.

Törkenczy & Siptár (1999) and Siptár & Törkenczy (2000) propose that deletion of the middle consonant in three-consonant clusters conforms to the following generalizations:[32]

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[32]Kenesei et al. (1998: 388) also mention cases of word-initial consonant deletion in "substandard dialects and in fast speech styles". These also mainly target stops, when they are followed by a nasal or another obstruent (see 28b): /pt-, ps-, pn-, ks-, kn-, gn-/. Strident fricatives in the same position never delete (/sk-, sp-, sf-, sn-, etc./), except when followed by another strident fricative or affricate /ʃtʃ, stʃ/. The remaining cases of possible deletion include: /ft-, mn-, ng-, hr-/. These cases will not be discussed any further.

(28)   GENERALIZATIONS IN CONSONANT DELETION (T&S 1999; S&T 2000):
    a.   Only stops delete; fricatives and affricates never do (27g-h).
    b.   Stops do not delete if preceded by a [+sonorant, +continuant] segment:
        glides (27f) and liquids (27d-e).
    c.   Stops do  not delete if followed by a [+continuant] segment:
        glides (31b), liquids (25, 27c), and fricatives (27a-b).

These generalizations are further supported by the examples below, also from Törkenczy & Siptár (1999) and Siptár & Törkenczy (2000). (29) illustrates the non-deletion of fricatives and affricates, even if the preceding segment is not a liquid or glide and the following one not [+continuant]. In (30) and (31) the medial stop is stable because it is preceded by a liquid or glide (30) or followed by a liquid, glide or a fricative (31).

(29)   NO DELETION IN $C_1C_2C_3$ CLUSTERS IF $C_2$ IS A FRICATIVE/AFFRICATE:
    a.   *könyvtár*      [kɔnʲfta:r]       *[kɔnʲta:r]        'library'
    b.   *eksztázis*     [ɛksta:ziʃ]      *[ɛkta:ziʃ]       'extasy'
    c.   *Amszterdam*  [ɔmstɛrdɔm]   *[ɔmtɛrdɔm]   'Amsterdam'
    d.   *inspekció*     [inʃpɛktˢio:]    *[inpɛktˢio:]     'inspection'
    e.   *obskurus*      [opʃkuruʃ]      *[opkuruʃ]       'obscure'
    f.   *lánctalp*       [la:ntˢtɔlp]      *[la:ntɔlp]        'caterpillar track'
    g.   *táncdal*        [ta:ndᶻdɔl]      *[ta:ndɔl]         'popular song'
    h.   *parancsnok*   [pɔrɔntʲnok]    *[pɔrɔnnok]     'commander'

(30)   NO DELETION IN $C_1C_2C_3$ CLUSTERS IF $C_1$ IS A LIQUID OR GLIDE:
    a.   *talpnyaló*      [tɔlpnʲɔlo:]      *[tɔlnʲɔlo:]        'lackey'
    b.   *partner*        [pɔrtnɛr]        *[pɔrnɛr]         'partner'
    c.   *fajdkakas*     [fɔjdkɔkɔʃ]     *[fɔjkɔkɔʃ]      'black cock'

(31)   NO DELETION IN $C_1C_2C_3$ CLUSTERS IF $C_3$ IS [+CONTINUANT]:
    a.   *pántlika*       [pa:ntlikɔ]       *[pa:nlikɔ]       'ribbon'
    b.   *kompjúter*     [kompju:tɛr]     *[komju:tɛr]     'computer'
    c.   *pemzli*         [pɛmzli]          *[pɛmli]          'brush'

The restriction to stops in this deletion pattern is just the first instance of a generalization that we will find again in numerous other deletion and epenthesis processes to be described in this section and the following chapters. Stops are more likely than other consonants to delete, trigger vowel epenthesis, or block vowel deletion. I interpret this as a more restrictive subcase of the first generalization: stops, more than other consonants, want to surface next to a vowel. I take this to be

the basic motivation in Hungarian for deleting stops that find themselves in interconsonantal position. Other languages, described in chapter 5, also delete stops that are not *followed* by a vowel, e.g. Basque and Marais-Vendéen. This constitutes our second generalization.

*Generalization 2*:   Stops, more than other consonants, want to be adjacent to a vowel, and preferably followed by a vowel.

Notice, however, that it is not the case that all stops surface next to a vowel in Hungarian: stops are often found in interconsonantal position, as in numerous examples in (25), (27), (30), and (31). The point is that only stops delete, and they do so only in interconsonantal position. But deletion is subject to additional conditions, to which I turn next.

The stability of stops before [+continuant] segments reflects transparently the next generalization. As will be explained in more detail in chapter 3, the role of the continuancy value of the following element on stop deletion can be related to the well-known tendency for stops to be possibly "unreleased", that is to lack an *audible* release, in certain contexts, essentially before [-continuant] consonants (oral and nasal stops) and in final position (Laver 1994: 359-360). These contexts form the complement set to [+continuant] elements. Since the burst plays an important role in the perception of stops, we can make sense of their greater vulnerability when not followed by a continuant segment.[33]

*Generalization 3*:   Stops that are not followed by a [+continuant] segment want to be adjacent to a vowel, and preferably followed by a vowel.

The fact that stops do not delete when preceded by a liquid or glide can be interpreted in terms of contrast in manner of articulation. Stops may delete only if preceded by a relatively similar consonant; deletion is blocked by a bigger contrast between the two segments. Stops contrast with liquids and glides in both continuancy and sonorancy, but in none or only one of these features with nasals and obstruents. Alternatively, we can use the major class system proposed in Clements (1990). Three major class features are used to distinguish among the consonants, which are defined in the following way:

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[33]It will become clear in the discussion of the French case why adjacency to vowels is important in the formulation of this and the following two generalizations, and why the correct one could not simply be something like "Consonants want to be followed by a [+continuant] segment" or, for the following generalization, "Consonants want to be adjacent to segments that are relatively dissimilar".

(32)    CLEMENTS'S (1990) MAJOR CLASS FEATURES:

|              | Obstruents | Nasals | Liquids | Glides |
|--------------|------------|--------|---------|--------|
| Sonorant     | –          | +      | +       | +      |
| Approximant  | –          | –      | +       | +      |
| Vocoid       | –          | –      | –       | +      |

The level of contrast between two classes of consonants can be derived by comparing the number of plus- or minus-specifications they are associated with. Obstruents have no plus-specifications, liquids and glides have (at least) two: [sonorant] and [approximant]. Stops thus contrast more with liquids than with nasals, which have only one plus-specification [sonorant], or fricatives. This is the system I will use in chapter 4 to deal with contrast in manner of articulation.

The role of contrast extends beyond manner of articulation and the data presented so far. It appears that when the conditions for deletion are met, not all stops are as likely to be dropped. An additional factor in the likelihood of deletion is homorganicity. A medial stop more readily deletes when it agrees in place of articulation with the preceding consonant than when it does not (Törkenczy, p.c.). Compare the two forms in (33), which contrast in the place of articulation of the medial stop – velar in (33a), alveolar in (33b) – the flanking consonants being alveolar and labial in both cases. Both stops may be dropped but according to Törkenczy, deletion is more frequent and natural in *parasztból*, in which $C_1$ and $C_2$ share the same point of articulation, than in *Recskből*. Note that it is really homorganicity, and not the coronality of the medial stop itself, that favors deletion, since non-coronal stops homorganic with the preceding segments also readily delete, as in (24a, 24d) repeated below.

(33)    STOP DELETION MORE LIKELY IN HOMORGANIC CLUSTERS:
a. *Recskből*     [rɛdʒgbøːl]     [rɛdʒbøːl]     'from Recsk'
b. *parasztból*   [pɔrɔzdboːl]    [parazboːl]    'from the peasant'

(24)    a. *lambda*     [lɔmbdɔ]     [lɔmdɔ]     'lambda'
d. *dombtető*   [dompt̪ɛtø]   [domt̪ɛtø]   'hilltop'

These facts about manner and place of articulation can be generalized and suggest that the more contrast there is between the medial stop and the adjacent segments, the more likely simplification is. In other words, dissimilarity with adjacent consonants protects the stop from deletion. It also prevents vowel epenthesis. This follows from the following generalization, to which chapter 4 will be

entirely devoted. This generalization is obviously related to the OCP, but requires a more general approach to contrast.

| *Generalization 4:* | Consonants that are relatively similar to a neighboring segment want to be adjacent to a vowel, and preferably followed by a vowel. |
|---|---|

Contrast in manner of articulation is also a major factor in the likelihood of degemination, interpreted as a specific instance of consonant deletion. According to Siptár (2000), the traditional generalization concerning geminates in Hungarian is that they only occur intervocalically (e.g. *áll Attila* 'Attila stands') and utterance-finally if preceded by a vowel (*áll* 'stand'). But this view is oversimplified: retention of gemination is in many contexts optional, and its likelihood depends on the nature of the flanking segments and the morphological and prosodic structure.

Siptár (2000), after Nádasdy (1989), distinguishes between underlying geminates (ex. *áll* 'stand'), those that arise from assimilation processes (ex. *báty-ja* [tʲː] 'his brother'), and those that arise through the juxtaposition of identical consonants at morpheme and word boundaries (ex. *comb-ból* 'from thigh'). The first two types (underlying and assimilation-based) constitute *true* geminates; they pattern together and contrast in their behavior with juxtaposition-based or *fake* geminates. Degemination occurs only next to a consonant, and a distinction is made between left-flanked and right-flanked geminates. Left-flanked true[34] geminates arise only at the word level and degemination is obligatory. I disregard this process of degemination and focus on the other cases of degemination, which apply to right-flanked true geminates and right- and left-flanked fake geminates.

Let us first look at fake or juxtaposition-based geminates, which optionally undergo degemination when preceded or followed by a consonant. Two cases arise: left-flanked geminates involve a morpheme/word ending in a cluster followed by a consonant-initial morpheme/word ($C_1C_2\#C_2$); right-flanked geminates occur at boundaries between a final consonant and an initial cluster ($C_1\#C_1C_2$). For them Siptár (2000) provides the following hierarchy of probability: degemination is most likely if the flanking consonant is an obstruent (O), less likely if it is a nasal (N), and least likely if it is a liquid (L). (See also Kenesei et al. 1998: 448.) This hierarchy holds across all morphological and prosodic contexts. The examples below illustrate the process with left-flanked (34) and right-flanked (35) geminates in compounds and at

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[34]The case for underlying left-flanked geminates is not clear; they occur at best in very limited contexts. See Siptár (2000).

word boundaries.[35] Since all initial and practically all final clusters begin and end, respectively, in an obstruent, this type of gemination concerns mostly obstruents.

(34)    DEGEMINATION OF FAKE LEFT-FLANKED GEMINATES:
        a.  In compounds:

| O- | *direkttermő* | [dirɛkt(:)ɛrmø:] | 'a type of wine' | \| degemination |
| N- | *csonttányér* | [tʃont(:)aːnʲeːr] | 'bone plate' | \| less |
| L- | *talppont* | [tɔlp(:)ont] | 'foot-end' | ↓ likely |

        b.  In phrases:

| O- | *most talán* | [moʃt(:)ɔlaːn] | 'now perhaps' | \| degemination |
| N- | *tank körül* | [tɔŋk(:)øryl] | 'around tank' | \| less |
| L- | *szerb bor* | [sɛrb(:)or] | 'Serbian wine' | ↓ likely |

(35)    DEGEMINATION OF FAKE RIGHT-FLANKED GEMINATES:
        a.  In compounds:

| -O | *kisstílű* | [kiʃ(:)tiːlyː] | 'petty' | \| degemination |
| -N | *őssmink* | [øʃ(:)miŋk] | 'proto-make-up' | \| less |
| -L | *széppróza* | [seːp(:)roːzɔ] | 'prose fiction' | ↓ likely |

        b.  In phrases:

| -O | *olasz sztár* | [olɔs(:)taːr] | 'Italian (film) star' | \| degemination |
| -N | *kész sznob* | [keːs(:)nob] | 'a perfect snob' | \| less |
| -L | *ügyes srác* | [ydʲɛʃ(:)raːtˢ] | 'smart boy' | ↓ likely |

These data can be interpreted in terms of syntagmatic contrast, using the feature specifications in (32). In cluster simplification, a stop adjacent to a liquid – that is, which contrasts in the feature [approximant] with a neighboring segment – is stable; see the examples in (27d-f) and (30). The same holds here, if we see the geminate as two segments: gemination is generally maintained when the geminate surfaces next to a liquid. When a geminate obstruent is adjacent to a nasal, it shows less contrast, i.e. only a contrast in the feature [sonorant] but not [approximant]. In this case degemination is more likely. When no contrast exists (according to the specifications in (32)), degemination is almost obligatory. This situation arises when the geminate occurs next to an obstruent.

Dressler & Siptár (1989) identify an additional factor in the likelihood of degemination: the strength of the prosodic boundary the geminate is adjacent to. The weaker the boundary, the more likely degemination is. They cite the following contrast between *párt#tag* 'party member' and *tart tőle* 'be afraid of'. The two forms

contain identical consonant sequences but degemination is more likely in the first one, in which the double consonant is only adjacent to a compound boundary, than in the second one, which involves a word boundary. The same hierarchy should hold within the data in (34) and (35).

I now turn to right-flanked underlying/assimilation-based (true) geminates. These provide a better illustration of the effect of the prosodic boundary and further support the role of contrast. Almost all consonants in Hungarian can be underlyingly geminated morpheme-finally. Dressler & Siptár (1989) state that geminate obstruents followed by another obstruent obligatorily degeminate word-internally, before suffixes as well as in compounds (36a-b). However, if the geminate and the following consonant contrast in sonorancy, they note that degemination may be avoided in formal speech (36c-e).

(36)    DEGEMINATION OF TRUE RIGHT-FLANKED GEMINATES WORD-INTERNALLY:

| a. | *lakktól* | /lɔk:-toːl/ | | [lɔktoːl] | 'from varnish' |
| b. | *üsd* | /yt-j-d/ | (ʒʒd) | [yʒd] | 'hit it!' |
| c. | *hallgat* | /hɔl:-gɔt/ | | [hɔl(:)gɔt] | 'listen' |
| d. | *sakkra* | /ʃɔk:-rɔ/ | | [ʃok(:)rɔ] | 'to chess' |
| e. | *mennybe* | /mɛɲ:-bɛ/ | | [mɛɲ(:)bɛ] | 'into heaven' |

In phrasal domains degemination is always optional and its likelihood correlates with the strength of the adjacent boundary. (37) shows a series of examples involving the sequence /ɲ:-b/, with an increasingly strong boundary from a. to g. Siptár (2000: 115) and Dressler & Siptár (1989) express this generalization in terms of syntactic boundaries. I believe this can unproblematically be reinterpreted in terms of prosodic boundaries.

(37)    DEGEMINATION OF TRUE RIGHT-FLANKED GEMINATES ABOVE THE WORD:

| a. | *menny+be* | 'into heaven' | affix boundary | \| |
| b. | *menny#bolt* | 'firmament' | compound boundary | \| |
| c. | *menj be* | 'go in!' | clitic boundary | \|Degem- |
| d. | *menj balra* | 'go left!' | word boundary | \|ination |
| e. | *menj, Béla* | 'go, Béla!' | phrase boundary | \|less |
| f. | *menj, bár* | 'go, although...' | clause boundary | \|likely |
| g. | *Menj. Balfelő* | Go! On the left-hand side...' | | \| |
| | | | sentence boundary | ↓ |

This establishes the final generalization about Hungarian, which concerns prosodic structure. It should be interpreted in a cumulative fashion. That is, for any

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[35]Left-flanked geminates also occur at suffix boundaries, but right-flanked ones do not, since there are no instances of suffixes beginning in a cluster attaching to consonant-final morphemes.

domain i, consonants at the edge are licensed more easily than domain-internal consonants. It follows that consonants at the edge of domain i are licensed more easily than consonants at the edge of domain j, if the edge of domain i constitutes a stronger boundary than the edge of domain j (in other words if domain i is higher in the prosodic hierarchy than domain j).

*Generalization 5:*     Consonants that are not at the edge of a prosodic domain want to be adjacent to a vowel, and preferably followed by a vowel.

This concludes our description of consonant deletion in Hungarian, which, as it will become clear after discussing these generalizations, has the ingredients of a classic case of cluster simplification, subject to well-attested and motivated constraints.

### 1.2.3.2. Attic Greek coronal stop deletion

In Attic Greek the possible contexts of occurrence of stops with different points of articulation are severely restricted. In Steriade (1982), followed by Itô (1986), these restrictions are said to result from a coda condition against stops, all cases of deletion resulting from Stray Erasure. In this section I argue that this syllable-based analysis is not desirable, for three different reasons. First, it does not account for the full range of facts in Attic Greek itself. Second, it crucially relies on restrictions on the application of a laryngeal assimilation rule that are not well motivated. Third, it is disconnected from other processes, in Greek as well as other languages, that achieve the same purpose: avoid certain stops in certain contexts. More specifically, I propose that the Attic Greek facts follow from a purely sequential constraint against coronal stops in pre-consonantal, in particular pre-obstruent, position (Wetzels 1989; Y. Kang 1999, 2000). This constitutes our sixth generalization:

*Generalization 6:*     Coronal stops want to be followed by a vowel.

Generalizations on attested non-geminate stops in Attic Greek can be summarized as follows:

(38)    GENERALIZATIONS ON THE OCCURRENCE OF STOPS IN ATTIC GREEK:
   a.  Non-coronal and coronal stops appear before sonorants.
   b.  Only non-coronal stops appear before obstruents; in this case the second obstruent is always a coronal.
   c.  No stops may appear in word-final position.

All morpheme-initial and morpheme-internal stops conform to the generalizations in (38a-b), as illustrated below. All data are taken from Steriade (1982). Syllable boundaries, as given in this reference, are indicated by a dot when relevant.

(39)    INTERNAL CORONAL AND NON-CORONAL STOPS IN PRE-SONORANT POSITION:
   a.  ʰag.nos    'holy'                 b.  or.pʰnɛ:    'darkness'
   c.  ked.nos    'careful'              d.  es.tʰlos    'good'

(40)    INTERNAL NON-CORONAL STOPS IN PRE-OBSTRUENT POSITION:
   a.  ok.tɔ:     'eight'                b.  ʰeb.do.ma   'week'
   c.  ark.sai    'to have begun'        d.  skep.sis    'consideration'

(41)    INITIAL CORONAL AND NON-CORONAL STOPS IN PRE-SONORANT POSITION:
   a.  gnɔ:mɛ:    'judgement'            b.  pʰlauros    'petty'
   c.  dnopʰos    'darkness'             d.  tlaɔ:       'to endure'

(42)    INITIAL NON-CORONAL STOPS IN PRE-OBSTRUENT POSITION:
   a.  kte:nɔ:    'to kill'              b.  ptuttɔ:     'to spit'
   c.  ksenos     'stranger'             d.  psauɔ:      'to touch'

When a stop finds itself in a disallowed environment, through morpheme concatenation, a repair strategy must be adopted. Deletion is of course one of them, and it is used in two contexts: word-finally (when a stem is followed by a null inflectional suffix) (43) and for coronal stops that appear before a non-coronal obstruent (44). The data in (44) are to be contrasted with those in (45), where a non-coronal obstruent remains before a coronal one.[36]

(43)    DELETION OF WORD-FINAL STOPS:
   a.  /gunaik+ø/        →       [gunai]         'woman+VOC'
   b.  /melit+ø/         →       [meli]          'honey+VOC'

(44)    DELETION OF CORONAL STOPS BEFORE A NON-CORONAL OBSTRUENT:
   a.  /ke+komid+k+a/    →       [kekomika]      'I have provided'
   b.  /pe+pɛ:tʰ+k+a/    →       [pepɛ:ka]       'I have persuaded'

(45)    RETENTION OF NON-CORONAL STOPS BEFORE A CORONAL OBSTRUENT:
   a.  /leg+tʰɛ:somai/   →       [lekʰtʰɛ:somai]    'I will be counted'

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[36]Steriade (1982: 300) notes that verbal stems ending in a labial or velar stop do not take the perfect /k/ suffix used in (44), so that no direct comparison is possible here between coronal and non-coronal stops in the same pre-stop context.

b.  /plek+dɛːn/          →     [plɛgden]          'entwined'

As a special case, non-coronal stops remain before the word-final vocative suffix /s/, which is assumed to be the only final extraprosodic consonant allowed in Attic Greek (46). By contrast, stems ending in a coronal stop do not take the vocative suffix /s/ and always lose they final segment, as in (43b).

(46)   NON-CORONAL STOPS BEFORE THE VOCATIVE SUFFIX /-s/:
       a.  /pʰleb+s/       →     [pʰleps]             'vein.VOC'
       b.  /pʰulaːk+s/     →     [pʰulaːks]           'guard.VOC'

Golston (1996) reports that the vocative suffix /s/ in Greek is historically epenthetic. It is hypothesized that it was added to save stem-final labial and velar stops from deletion.[37] I suggest that /s/ epenthesis after final stops may be related to the third generalization, presented in the context of Hungarian: a stop wants to be followed by a [+continuant] segment. In final position after a stop, a fricative is the only epenthetic segment that will comply with the desire for stops to be followed by a [+continuant] segment, without generating a violation of the SSP or create an additional syllable or sonority peak. A similar process of /s/ epenthesis after stops can be found in Limburg Dutch (Hinskens 1996). But this hypothesis clearly needs to be investigated further. Now, why was /s/ not added to stems ending in coronal stops? A possible reason is that this would not have saved coronal stops from deletion anyway, since, as we will see below, they were subject to assimilation and deletion before coronal obstruents.

Steriade (1982), followed by Itô (1986), proposes a syllabic account of the restrictions on obstruents in Greek. The idea is that Greek imposes a coda condition that bans all stops from this position, formulated as follows by Itô (1986):

(47)   ATTIC GREEK CODA CONDITION (Itô 1986):
            * C]σ
             |
         [-son, -cont]

This coda condition directly takes care of the data in (43). The final stop can neither be an onset nor an extraprosodic segment (/s/ being the only extraprosodic consonant allowed). It cannot be incorporated into a coda because of the coda

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[37]Note that the form in (43a) is one of the exceptions to the addition of the vocative /s/. Another such exception is *ana* 'king.VOC', which is found only in Homer, other dialects having regular *anaks*.

condition (47). It is therefore stray-erased. For this analysis to account for the behavior of other stops, three additional hypotheses are necessary. The first one relates to the syllabification rules of consonant clusters. Steriade argues that all sequences of a voiceless stop followed by a sonorant and a voiced stop followed by [r] obligatorily form complex onsets. Sequences of a voiced stop followed by a liquid ([bl, gl]) may also constitute complex onsets, but this is only an option. The stops in (39b,d) and (41b,d) are all voiceless and followed by a sonorant; therefore they are part of complex onsets and are not subject to the coda condition.

The second additional hypothesis has to do with the constraints on the application of coda conditions. Crucially, coda conditions apply only to singly-linked segments, i.e. segments that are exhaustively contained in the coda. This linking constraint, developed in Hayes (1986b), saves from Stray Erasure consonants that have doubly-linked features with the following onset or extrametrical segment. Steriade (1982) proposes for Attic Greek a Laryngeal Feature Assimilation (LFA) rule that spreads the laryngeal features of a *coronal* to the preceding obstruent. Sequences such as /gtʰ/ (45a) /kd/ (45b) and /bs/ (46a) become respectively [kʰtʰ], [gd] and [ps] by LFA. The example in (45b) is illustrated in (48a). Through this assimilatory process, non-coronal stops preceding coronal obstruents escape deletion: laryngeal features being now doubly linked in these sequences, the coda condition against stops does not apply, and [g] is safely incorporated (and licensed) in coda position. The same mechanism applies (vacuously or not) in (39a,c) and (40).

(48)   LARYNGEAL FEATURE ASSIMILATION AND STRAY ERASURE:
       a.         Rime Onset

                  ╱╲    |
              C C V C  C V C
              | |  | |  | | |
              p l e k  d ɛ n          →          [plegdɛːn]
                 ╱╲  |
            [-voice] [+voice]


       b.          Rime  Onset

                    | ╲ |
              C C V C  C V  C C V
              | |  | |  | |  | | |     Stray Erasure
              k e-k o  m i  d-k a          →          [kekomika]
                     |  |
                   [+v] [-v]

But the coda condition against stops does apply to the forms in (44), in which the stop is followed by a non-coronal obstruent. Since laryngeal spreading does not originate from non-coronals, the preceding coronal stop does not contain doubly-linked laryngeal features and is consequently subject to the coda condition. It cannot be incorporated into a syllabic constituent and is subsequently stray-erased. This is illustrated in (48b) for the example in (44a). The consonant [d] has not linked features with the following onset [k], so it cannot form a coda and attach to the preceding rime.

The final hypothesis concerns word-initial consonants that can neither be part of a complex onset nor be incorporated into a coda at the word-level, i.e. those in (41a,c) and (42). These consonants are saved from deletion by syllabifying as codas at the phrasal level, or adjoining to the following syllable by a late adjunction rule.

This analysis accounts for the given data, but there are reasons to doubt that it is the correct one. Two of these reasons have also been mentioned by Yip (1991). First, recall that the generalizations in (38a-b) – the contrast between coronal and non-coronal stops in pre-obstruent position – apply not only to coda stops but also to word-initial sequences. This total convergence is accidental in the syllabic account, since word-initial stops are licensed by a completely separate mechanism, i.e. late adjunction or extrasyllabicity. I believe the ideal analysis should unify those cases, and such an analysis seems not to be syllabically-conditioned, since the data to be accounted for are found in different syllabic positions. The discussion to follow further supports this point.[38]

Second, the laryngeal linking constraint on the application of the coda condition crucially depends on LFA being triggered only by coronals. The evidence brought by Steriade for this restriction in Attic Greek is unclear, as it relies on a delicate issue of phonetic interpretation of orthographic signs. Furthermore, I am

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[38]Yip (1991) also extends this criticism to Diola Fogny. This language allows only homorganic consonant clusters: nasal-stop ones, plus, morpheme-internally, /lt/ and /rt/. Other clusters automatically simplify by deletion. Steriade's (1982) and Itô's (1986) account of these data (based on Sapir 1965) involves a coda condition against all consonants, which does not apply to those that have doubly-linked place features. However, Diola Fogny also permits extra consonants at both edges of words, e.g. [mba] 'or', [bunt] 'lie'. Clusters at word edges are subject to the homorganicity condition, just like word-internal ones, but the coda condition does not deal with word-initial ones. Again, this convergence is accidental in the syllabic analysis. To remedy this problem, Yip suggests that Diola Fogny rather obeys a cluster condition, that prohibits adjacent consonants with more than one place specification, coronals being unspecified for place. I concur with Yip that consonant deletion and phonotactics in Diola is not syllabically-based. But a complete analysis of the facts has yet to be developed, since the cluster condition alone allows numerous unattested clusters.

not aware of a cross-linguistic tendency for laryngeal assimilation to be preferentially triggered by coronals (see Steriade 1999c). Steriade (1982: 231-232 and section 5.5.5) argues that there is no voicing assimilation in the /s/+non-coronal stop clusters. The data she mentions are *pelasgos* and *presbus*, in which the clusters are spelled <sg (σγ)> and <sb (σβ)> respectively. This contrasts, I assume, with the absence of clusters spelled <sd (σδ)>. It is not clear, however, how the sign <σ> should be interpreted phonetically. The difficulty here lies in the fact that there was no sign to transcribe the sound [z], but there was one for the sequence [zd], i.e. <ζ>. Assimilation in /s/+coronal stop clusters was therefore easy to transcribe, but not that in /s/+non-coronal stop sequences. It is conceivable that <σ> was used for both [s] and [z] in contexts other than [zd], and that assimilation took place from coronal and non-coronal obstruents alike. Steriade thinks it was not the case, and argues that <δ> could be used to transcribe [z], and would have been used in words like *pelasgos* and *presbus* if assimilation had applied. One would prefer to have more solid arguments for restricting laryngeal assimilation to coronal triggers, especially given the crucial role that this restriction plays in Steriade's syllabic account. But in any case, there are additional empirical problems with this analysis, to which I now turn.

The syllabification rules argued for by Steriade (1982) were also crucial, specifically the fact that all voiceless stop+sonorant clusters obligatorily form complex onsets. Since these sequences disagree in voicing, the stop cannot have doubly-linked laryngeal features and must be in onset position to avoid stray erasure (if it is not subject to word-initial adjunction). This syllabification rule, however, is questionable, and has been revised in Steriade (1999c). In this later paper she supports syllabifications like [mak.ro.te.ros] 'longer', with voiceless stops in coda position (see also Devine & Stephens 1994). Golston (1996) also gives the syllabifications [a.rith.mos] 'number' and [e.ret.mon] 'oar', but does not justify them. A second crucial assumption for the syllabic analysis to work thus turns out to be problematic. This point will become even clearer when I discuss the Latin facts below.

The third objection that can be raised against this account is that it misses what seems to be the correct generalization. The discussion so far has ignored one important category of data: what happens to coronal stops when they precede another coronal obstruent? The approach presented predicts that coronal stops should be licensed in coda position in this case, since LFA is expected to take place. In fact, no sequence of a coronal stop followed by a coronal obstruent surfaces in Greek. The difference from clusters of a coronal stop before a *non*-coronal obstruent is that here the stop does not delete, as in (44), but becomes [+continuant]. This is

true both before /t,d/ (49a-b) and before /s/ (49c-e). Laryngeal assimilation and degemination subsequently apply.

(49)    FRICATIVIZATION OF CORONAL STOPS BEFORE CORONAL OBSTRUENTS:
    a.    /komid+tɛ:+s/        →    [komistɛ:s]        'one who takes care of'
    b.    /koruth+tɛ:+s/       →    [korustɛ:s]        'man with a helmet'
    c.    /pod+si/        →    (possi)    →    [posi]        'foot+DAT.PL'
    d.    /ornith+si/     →    (ornissi)    →    [ornisi]        'bind+DAT.PL'
    e.    /kharit+s/      →    (khariss)    →    [kharis]        '??+NOM.SG'

This change in continuancy is accounted for by Steriade by a linear rule triggered by and targeting coronal obstruents, a rule that is completely disconnected from stray erasure of coronal stops before non-coronal obstruents. (They are in some sense radically different as one is sequential and the other one prosodic.) Notice, however, that the result of the continuancy and deletion rules is the same: they both remove coronal stops from a pre-obstruent position. If the two processes have the same motivation, they should be linked in the grammar, which is not the case here. Data beyond Attic Greek strongly suggest that they should indeed be put together, as the avoidance of coronal stops in pre-obstruent (and more generally pre-consonantal[39]) position is a well-attested tendency cross-linguistically (Blust 1979; Y. Kang 1999, 2000), and is achieved by a variety of means. Attic Greek uses stop deletion and fricativization, Tagalog metathesis and assimilation. Yakut (Wetzels 1989) and Latin use assimilation alone.[40] This convergence of the Greek facts with known crosslinguistic tendencies provides strong evidence that coronal stop deletion in this language is not syllabically-driven but motivated by a stricty sequential constraint against pre-obstruent coronal stops. The shortcomings of the prosodic approach to the deletion process further support this conclusion.

A comparison with Latin sheds additional light on the Greek data. Word-internally, Latin looks just like Attic Greek and the generalizations in (38a-b) equally apply to it. Coronal stops are allowed before a sonorant (50), but only non-coronal ones appear before an obstruent (which is always coronal in this case) (51)-(52). The discussion of the Classical Latin facts is based primarily on Jacobs (1989).

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[39]Coronal stops may also delete, fricativize, or assimilate before sonorant consonants in both Greek and Latin, but the relevant cases are restricted to specific (morphological) contexts, and are much more limited than before obstruents. The language retains numerous examples of coronal stop+sonorant sequences. This suggests that coronal stops are marked before all consonants, but more so before obstruents.

[40]The weakness of pre-consonantal coronal stops is also reflected in English in the behavior of word-final stops. Coronal stops assimilate to a following obstruent (*ten pounds* [mp], *hot cakes* [kk]), but non-coronal ones remain intact (*home town* \*[nt], *ping pong* \*[mp]) (Mohanan 1993; Jun 1995).

(50)    CORONAL STOPS BEFORE A SONORANT:
    a.    *rhythmus*                'symmetry, rhythm'
    b.    *athleta*                 'athlete'
    c.    *atlantion*               'atlas (the first cervical vertebra)'

(51)    MORPHEME-INTERNAL NON-CORONAL STOPS BEFORE AN OBSTRUENT:
    a.    *doctor*                  'doctor'
    b.    *sculptor*                'sculptor'

(52)    NON-CORONAL STOPS BEFORE AN OBSTRUENT ACROSS A BOUNDARY:
    a.    *clepsi*     /klep+si/     'steal+PERF'
    b.    *dixi*       /dik+si/      'say+PERF'
    c.    *urbs*       /urb+s/       'city+NOM.SG'
    d.    *arx*        /ark+s/       'stronghold+NOM.SG'

One interesting point about the data in (50) is that both Steriade (1982) and Jacobs (1989) argue that [tm] and [tl] can clearly not form complex onsets in Latin, in particular because they do not appear word-initially (except in the Greek borrowing *tmesis*). The voiceless stop therefore has to be in the coda, and the coda condition+LFA approach proposed for Greek cannot work for Latin. Yet the two languages look so similar that one expects a similar analysis.

However, Latin differs from Attic Greek in the strategy used to prevent coronal stops from appearing before an obstruent. In Latin coronal stops assimilate to the following obstruent, yielding a geminate consonant. This is true both before coronal and non-coronal obstruents. Thus, unlike Greek, Latin treats all pre-obstruent coronal stops alike, and this further casts doubt on the radical distinction made between the deletion and fricativization processes in Greek. For example, coronal stops assimilate before the suffix /-kus/ (Steriade 1982: 277-278) (53a), the nominative singular /s/ (53b-c) or the perfective suffix /-si/ (53d-f) (Monteil 1970). Degemination of the resulting geminate takes place word-finally and after a consonant, a long vowel, or a diphthong (Monteil 1970: 311).[41] The forms in (53) contrast with those in (52), in which the stem ends in a non-coronal stop. Massive regressive assimilation is also found at the boundary between the prefix *ad-* and consonant-initial stems, e.g. /ad-porto/ → *apporto*, /ad-grego/ → *aggrego*. *Ad-* contrasts with *ab-* in this respect, e.g. /ab-grego/ → *abgrego*.

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[41]In fact, Jacobs (1989) ambiguously talks about deletion and assimilation of coronal stops in Latin. Since all the examples he gives involve degemination (except the crucial case in (53f) in a footnote), deletion and assimilation yield identical results. Monteil (1970) is clear about assimilation.

(53)    ASSIMILATION OF CORONAL STOPS BEFORE AN OBSTRUENT:
     a. *siccus*    /sit+ko+s/    'dry+NOM.SG'    (cf. *sitis*    'thirst')
     b. *cohors*    /cohort+s/    'cohort+NOM.SG'    (cf. *cohorti*    'cohort+GEN.SG')
     c. *lis*    /lit+s/    'fight+NOM.SG'    (cf. *litis*    'fight+GEN.SG')
     d. *clausi*    /claud+si/    'close+PERF'    (cf. *claudo*    'close+PRES.1SG')
     e. *sensi*    /sent+si/    'feel+PERF'    (cf. *sentio*    'feel+PRES.1SG')
     f. *concussi*    /concut+si/    'feel+PERF'    (cf. *concutio*    'feel+PRES.1SG')

To complete the description of the Latin patterns, a quick word about the fate of word-final stops. If Latin looks like Attic Greek word-internally, it differs from it word-finally. Whereas Greek disallows all stops in this position (38c), Latin permits them.

(54)    WORD-FINAL STOPS IN LATIN:
     a. *caput*                 'head'
     b. *lac*                   'milk'

Let us now return to our initial concern about the syllabic motivation for consonant deletion. What can we conclude from the discussion on Greek? The syllabic account based on a coda condition is problematic for Greek itself, and it cannot extend to very similar facts in related languages, as shown by Latin. An analysis of the generalizations on stops in the two languages should rest on the general tendency to avoid pre-consonantal, in particular pre-obstruent, coronal stops. This was our sixth generalization, repeated below. Pre-obstruent stops typically occur in coda, but are by no means restricted to this position. It follows that a phonological account of this phenomenon should be sequential rather than syllable-based in character.[42] Wetzels's (1989) Preconsonantal Decoronalization

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[42] Yip (1991) also concludes that the obstruent cooccurrence restrictions in Greek are not syllabically-driven but obey a cluster condition defined on sequences of consonants (see note 38). The alternative analysis she proposes, however, is not satisfactory. Her cluster condition states that adjacent consonants cannot have more than one place specification, coronals being unspecified for place. This linear condition explains the absence of clusters like [kp], with two non-coronals, in Greek, but does not alone account for the contrast between /kt/, which surfaces intact, and /tk/, which simplifies to [k]. Both clusters contain only one non-coronal and fare equally well with respect to the cluster condition. Yip's analysis works only if we add to it something along the lines of the association rule she proposes for English (p. 64): Associate place with leftmost [-continuant] consonant. This solution is not optimal, for two reasons. First, the marked status of coronal-first obstruent clusters is valid cross-linguistically; it is then undesirable to account for it by means of language-specific association rules. Second, and more importantly, Yip's cluster condition freely allows coronal stop+coronal obstruent clusters since they do not contain more than one place specification. The facts tell a different story: coronal stops are disfavored before all obstruents.

Principle, expressed in a rule-based framework, and Y. Kang's (1999) perceptually-based analysis in Optimality Theory (to which we will return) conform to this requirement.

*Generalization 6:*      Coronal stops want to be followed by a vowel.

Two things remain to be addressed to complete the picture of stops in Attic Greek and Latin, First, how should we account for the word-final facts? In Steriade/Itô's account of Greek, word-final deletion is intimately linked to word-internal deletion. It is striking, though, that in both Latin and Greek, the word-final conditions apply to all stops alike, whereas the word-internal facts crucially distinguish coronal from non-coronal stops. This suggests that the fate of word-final stops is not directly linked to that of word-internal ones. Word-internal stops are subject to the principle of avoidance of pre-consonantal coronal stops. Word-final ones depend more on language-specific edge effects. It is well-known that special conditions often apply at word margins. These often allow for more consonants or more complex ones than found in word-internal codas (e.g. Latin), but other languages put additional restrictions word-finally. Attic Greek and a number of Australian languages (Hamilton 1996) are of the second type. (See chapter 5 for a discussion of edge effects.)

Finally, it was noticed that in stop-obstruent clusters in Attic Greek and Latin, the second obstruent is always coronal. This is not predicted by the principle of avoidance of pre-consonantal coronal stops. I here follow Jacobs (1989), who concludes that the tendency to avoid clusters entirely composed of non-coronals is independent from that to avoid pre-consonantal coronal stops. Among the languages that actively eliminate pre-consonantal coronal stops, some allow clusters of non-coronals (Cebuano Bisayan, Yakut), for example [kp, pk], as well as [kt, pt]. But others only have coronals in second position (Greek, Latin, Tagalog), allowing [kt, pt] but not *[kp, pk]. To account for the latter set of languages, we could adopt Clements's (1990) Sequential Markedness Principle, or Yip's (1991) cluster condition (see note 42), which both favor structurally less complex segments. All else equal, this favors coronals over non-coronals if the former are unspecified for place.

### 1.2.3.3. English final coronal stop deletion

All varieties of English display a process of final stop deletion in clusters, which has been among the most extensively studied variable phenomena, especially in the sociolinguistic literature (e.g. Shiels-Djouadi 1975; Algeo 1978; Guy 1980, 1991a, 1991b; Neu 1980; Temperley 1987; Khan 1991; Santa Ana 1992, 1996; Kiparsky 1993,

1994; Bayley 1994; Reynolds 1994; Guy & Boberg 1997; and Labov 1997, who also summarizes the research on this topic since the 60', with older references). Classic examples of this process are *old̸ man* and *west̸ side*. This variable process applies after all types of consonants, depending on a number of well described grammatical and extra-grammatical factors:

• Nature of the preceding segment
• Nature of the following environment (segment, pause)
• Morphological status of the final stop
• Social and personal characteristics of the speaker
• Register / style

What has not been addressed, however, is the question: Why is it only stops that are subject to deletion and not other consonants? As is already clear, English is not isolated in targeting stops in cluster simplification: this is an instantiation of the second generalization, given for Hungarian above, that stops want, more than other consonants, to be adjacent to or followed by a vowel. The answer to the question "why stops?" will come in the next chapter.

The research has examined almost exclusively the deletion of alveolar stops /t,d/, as illustrated by the two examples cited above. But this should not be taken to imply that other stops cannot be dropped; they can. The focus on /t,d/ in the sociolinguistic literature is motivated by the fact that the vast majority of stop-final clusters in English end in an alveolar stop, and only they can cluster with a full range of preceding consonants. To the extent that sociolinguistic studies aim at statistically meaningful results based on natural speech corpora, the limited distribution and reduced frequency of labial- and velar-final clusters justified their exclusion from the studies (see Guy 1980). I will follow the existing literature and also restrict my attention to coronal stops.[43]

The factor I am concerned with in English final stop deletion is the adjacent phonological context. Regarding the preceding segment, studies on a variety of dialects converge on one result: the more similar the final stop is to the preceding segment, the more likely it is to delete. This follows from generalization 4, noted for Hungarian, that consonants want to be adjacent to segments that are relatively dissimilar. The opposite situation makes them more susceptible to deletion. One

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[43]Independently from frequency, it could be that coronal stops are associated with a significantly higher propensity to delete than other stops. This would be consistent with the greater vulnerability of coronal stops to delete in non-prevocalic position, as illustrated by the Attic Greek case. I leave the question open.

particular interest of the convergence between the English and Hungarian results (in addition to those reviewed in chapter 4, in particular Québec French) is that they are based on different kinds of data: the sociolinguistic literature on English coronal stop deletion uses actual frequencies based on corpora, whereas the Hungarian and other patterns derive from introspective acceptability judgments.

Similarity can be described in terms of shared features. Interestingly, varieties of English differ on what shared features trigger deletion. In their study of Philadelphia English, Guy & Boberg (1997) observe that final stops delete more frequently in natural speech after the segments in (55a) and least frequently (practically never) after those in (55c), the segments in (55b) forming an intermediate category:

(55)    LIKELIHOOD OF STOP DELETION ACCORDING TO THE PRECEDING SEGMENT:
        a.  stops (*act*), coronal fricatives (*wrist*), /n/ (*tend*, *tent*)
        b.  /l/ (*cold*, *colt*), non-coronal fricatives (*draft*), non-coronal nasals (*summed*)
        c.  /r/ (*cart*), vowels (*cat*)

A clear pattern emerges from this hierarchy: the more features /t,d/ share with the preceding segment, the more likely they are to delete. Using the features [coronal], [sonorant], and [continuant], it is easy to see that the segments in (55a) share two features with /t,d/, those in (55b) one feature, and those in (55c) no features (assuming that coda /r/ in this dialect is really vocalic in nature and does not carry the feature [coronal]). The same results obtain with the feature [approximant] rather than [continuant], as in (32) above. The addition of [voice] to the set of relevant features confirms these results, as clusters that agree in [voice] are reduced more often than those whose members do not share the same value for that feature, all else being equal.

Other dialects tend to favor specific features, i.e. deletion is triggered not by an overall level of contrast, as in Philadelphia English, but by agreement on a particular dimension between the coronal stop and the preceding segment. In Black and Puerto Rican English, the deletion of stops in word-final clusters is closely correlated with agreement in voicing between the members of the cluster. Thus, in Black English, the percentage of simplification in clusters that agree in voicing oscillates between 60% and 86%, whereas this number drops to around 0-13% for clusters that disagree in voicing. For example, after /n/, the percentage of /d/-deletion is 86%, as opposed to 13% for /t/ (Shiels-Djouadi 1975). In the variety of Indian English studied by Khan (1991), place of articulation plays a more dominant role than voicing or manner of articulation, so that heterorganic stop-stop clusters

/pt, kt/ are reduced significantly less often than homorganic sonorant-stop ones /ld, nd/, even though the latter display more contrast in manner of articulation.

The role of contrast/similarity, analyzed in OCP terms by Guy & Boberg (1997), seems to be orthogonal to syllable well-formedness and does not constitute an argument in the debate about the status of the syllable in deletion and epenthesis processes. More interesting for our purposes is the context following the final stop.

Many have analyzed the effect of the following context in terms of resyllabification possibilities. The retention of a final consonant is favored when it can be integrated into a following onset (Guy 1991b; Kiparsky 1993, 1994; Reynolds 1994). This directly explains why final stop deletion is very rare, in most dialects, before vowel-initial words. Before consonant-initial words, the resyllabification approach predicts that we should observe less frequent deletion before consonants which are attested as the second element of complex onsets after /t,d/, that is /r/ and the glides /w,j/, which are the most sonorous consonants. Independently of, or in addition to, the effect of attested complex onsets in English, it has been proposed that the frequency of stop retention correlates with the sonority level of the following consonant: the lower the segment on the sonority scale (3), the more likely deletion is (e.g. Guy 1991b; Santa Ana 1991, 1996; Bayley 1994; Reynolds 1994). Sonority can obviously be integrated into a resyllabification approach, since the goodness of complex onsets cross-linguistically is assumed to correlate with the difference in sonority between the elements of the cluster. /r,w,j/ are the consonants that may appear with /t,d/ in complex onsets; they are also the most sonorous consonants.[44] Resyllabification, on the basis of both English-specific phonotactics and universal sonority tendencies, predicts the following hierarchy: obstruents > nasals > /l/ > /r,w,j/, with stop deletion being maximally favored by a following obstruent.

The facts fail to support this account of the effect of the following segment. First, sonority as a factor in the deletion of /t,d/ has been investigated in particular by Santa Ana (1991, 1996) for Chicano English and Bayley (1994) for Tejano English. In both Tejano and Chicano English, stops delete before nasals more than any other class of consonants. In Tejano English, they also delete more often before /l/ than before fricatives other than /s/. These results are inconsistent with the sonority hierarchy. More problematic data come from Labov's study of Philadelphia English. His investigation of word-final /t,d/ deletion in English shows that a resyllabification

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[44]Liquids are grouped together in the sonority hierarchy in (3), but it has often been suggested that /r/ is in fact more sonorous than /l/, in particular in earlier works in this topic (Sievers 1881; Jespersen 1904; Vennemann 1988).

approach, however it is implemented, cannot explain the effect of the following segment on the variable retention of the stop. Based on two Philadelphian speakers' spontaneous speech, segments can be grouped as in (56), the segments in (56a) triggering deletion more than those in (56b), and those in (56b) more than those in (56c).

(56)    LIKELIHOOD OF STOP DELETION ACCORDING TO THE FOLLOWING SEGMENT:
        a.    stops, fricatives, /w/, nasals              more deletion of preceding /t,d/
        b.    /h/, /l/                                                      ↓
        c.    /j/, /r/, vowels, pause                     less deletion of preceding /t,d/

One element in this scale immediately stands out: the position of /w/. Resyllabification predicts at least that the consonants /r,w,j/ and the vowels will not favor deletion of the preceding stop. While /r,j/ and the vowels correctly appear at the bottom of the scale, the presence of /w/ alongside obstruents and nasals is mysterious. The contrast between /j/ and /w/ is even more unexpected since /tj, dj/ are actually highly restricted onsets in American English, in contrast with /tw, dw/. If anything, we should expect more deletion before /j/ than before /w/. This obstruent-like behavior of /w/ is not exceptional and has been reported in several past studies of /t,d/ deletion.

Labov also did a careful study of 150 tokens in which the final stop was kept before /r,w,j/ and vowels, looking for phonetic evidence that could tell whether /t,d/ behave as onsets or codas (aspiration, voicing, release, glottalization, flapping). In most cases, no clear conclusion could be drawn. But in the vast majority of cases for which a conclusion could be reached (40 tokens), it appeared that they were clearly incompatible with resyllabification of the stop in onset position. Only 5 tokens showed /t,d/ to be in onset position; four of them involved a following /j/, which triggered palatalization of the preceding stop, as in *told you* [toldʒu].

These results suggest that a resyllabification approach to /t,d/ deletion is supported neither by the phonetic facts nor by the frequency data. Labov therefore wonders what alternatives can be investigated. Although he does not develop the idea, he suggests that perception would be the most fruitful direction to explore. He only mentions the difference between /j/ and /w/: /t,d/ is quite salient before /j/ because the clusters tend to form a noisy affricate /tʃ, dʒ/. No such tendency is observed with /w/. The contrast between /w/ and /r/, however, is left unaddressed. Unfortunately, I will have no better solution to offer. The rest of this dissertation supports Labov's suggestion that perception may bring new insight to

our understanding of deletion patterns, but the effect of the following segment on coronal stop deletion in English will not be among the issues discussed.

### 1.2.3.4. Icelandic consonant deletion

Itô (1986) states that consonant deletion in Icelandic is a straightforward case of Stray Erasure, which automatically deletes unsyllabifiable consonants. She assumes that Icelandic consonants conform to the following restrictions: only one consonant is allowed in coda and complex onsets are permitted provided they have the right sonority profile. These conditions lead to the following two predictions: 1. underlying word-internal three-consonant sequences XYZ may surface only if YZ form a permissible onset, the sequence being syllabified as X.YZ, and 2. if YZ is not an acceptable onset, it is always the middle consonant Y that is lost, since the first and the last can always be syllabified in coda and onset positions, respectively.

In support of her analysis, Itô provides the data in (57)[45], which all contain an internal three-consonant sequence, represented in the orthographic form. In all cases, the first consonant automatically goes into the coda. In (57a), the remaining two consonants form a permissible complex onset, and all the segments are properly licensed. In the last two cases, the medial consonant is lost since neither [ḅḍ] nor [vn], according to Itô, are acceptable onsets given their sonority profile. The deleted consonant is crossed in the orthographic form.

(57)    CONSONANT DELETION IN THREE-CONSONANT SEQUENCES IN ICELANDIC:
   a. *timbri*          [tʰɪm.bʳɪ]        'timber.DAT'
   b. *kembdi*          [cʰɛm.ḍɪ]        'comb.PRET'
      cf. *kemba*       [cʰɛm.ba]        'comb.INF'
   c. *hálfna*          [haul.na]        'finish one half.INF'
      cf. *hálfur*      [haul.vʏɾ̥]        'half.NOM'

In this section I test Itô's predictions on a well-defined yet rich enough set of data. I investigate clusters formed by the addition of the past tense morpheme *-di/-ti/-ði* directly to verb stems ending in two consonants. The form in (57b) is one such example (*kemb+di*). The relevant verb stems, in Einarsson's (1945) terminology, are those pertaining to the first three classes of weak verbs. The fourth class, the most productive one, uses /-aðɪ/ as the preterit suffix, which automatically prevents the formation of new clusters in morpheme concatenation. The factors that determine the choice of the allomorph *-di*, *-ti* or *-ði* with each verb can be considered irrelevant

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[45]The phonetic transcriptions are those given in Einarsson (1945), adapted according to the indications in footnote 47.

and I simply take this choice as given. I leave aside stems ending in a coronal stop or non-sibilant fricative, which involve the formation of geminate consonants when followed by the preterit suffix, e.g. *hlýddi* 'obey.PRET' [hlɪḍːɪ] (cf. *hlýða* [hlɪða] 'obey.INF'). These geminate consonants then degeminate in post-consonantal position: *sendi* 'send.PRET' [sɛnḍɪ] (cf. INF. *senda* [sɛnḍa]).

These preterit forms provide enough information to allow us to safely identify relevant generalizations, but a complete description of consonant deletion in Icelandic will not be undertaken here. I use the data obtained from two native speakers of Icelandic, noted H and O.[46] These data are complemented by the pronunciations indicated in Blöndal (1920) (B), Einarsson (1945) (E), Rögnvaldsson (1989) (R) and, to a lesser extent, Halle & Clements (1983: 163) (who cite Höskuldur Thráinsson as their source).[47]

What first strikes the analyst about consonant deletion in weak preterits is its variability. There are classes of verbs that do not display any variation, deletion being for all speakers obligatory or excluded. But in a large part of the data, speakers have quite different judgments on a given item, deletion is often optional, and the same speaker may treat differently verbs that contain the same consonant sequences. Itô's syllabic analysis is unable to account for this variability and the data often contradict the two predictions given at the outset of this section: 1. deletion is automatic if the last two consonants do not form a permissible complex onset; 2. it is

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[46]I thank Ólafur Páll Jónsson and Haraldur Bernharðsson, as well as Hanna Óladóttir, for patiently going through a long list of verbs with me and answering my questions. Haraldur also provided me with useful references and easy access to Blöndal (1920), Rögnvaldsson (1989), and Helgason (1993). I should also note that Ólafur is from the South-east of Iceland, while Haraldur is from the North. The different geographical origin might explain at least part of the important differences that exist between the two speakers, but its significance is not clear yet and I do not want to extend their individual patterns to a larger domain or community.

[47]I adopt here an IPA transcription. When using data from Blöndal (1920) and Einarsson (1945), I have made the following adaptations in accordance with the IPA and/or in conformity with other sources (e.g. Rögnvaldsson 1989; Helgason 1993):
-[kʲ, gʲ] are replaced with [c, ɟ]                    -[q] is replaced with [ɣ]
-[ŋ] before [c] ([gʲ]) is replaced with [ɲ]           -[þ] is replaced with [θ]
-[λ] is replaced with [ʎ]                             -[ρ] is replaced with [r̥]
Icelandic stops are all phonetically voiceless but show a contrast in aspiration. Voiceless unaspirated stops normally correspond to orthographic <b,d,g>. Stops corresponding to orthographic <p,t,k> are usually aspirated but become unaspirated when preceded by a voiceless fricative, nasal, or liquid. Authors vary in their transcription of unaspirated stops: Rögnvaldsson (1989) systematically uses [ḅ,ḍ,g], Helgason (1993) systematically writes [p,t,k]. Einarsson (1945) distinguishes the underlyingly unaspirated [ḅ,ḍ,g] from the deaspirated [p,t,k]. Blöndal (1920) does not note devoicing of orthographic <b,d,g> and simply transcribed them [b,d,g]. I follow Einarsson's practice here, and adapt the other authors' transcriptions accordingly. This decision allows me to mark the underlying distinction among unaspirated stops.

always the second consonant that is dropped. The observed patterns can rather be largely understood in terms of three of the sequential tendencies uncovered in this chapter: 1. the special status of stops, extended to non-strident fricatives; 2. contrast within the cluster; 3. the Sonority Sequencing Principle.

In presenting the data I distinguish between two main categories of clusters that appear stem-finally: those that include an obstruent and those that do not. Let us first look at the no-obstruent group, comprised only of liquid+nasal stems, specifically /lm/, /rm/, and /rn/. In the preterit form of these verbs the cluster-medial nasal never deletes in any of my sources. Only cluster-initial /r/ may be dropped, subject to some individual or dialectal variation. /lm/ clusters before the preterit morpheme surface intact for my two informants, and neither Einarsson nor Rögnvaldsson, who otherwise give a complete list of cases of consonant deletion, note the dropping of a consonant in such forms. This is shown in (58); the consonant that would be expected to delete according to Itô's syllabic analysis is underlined.

(58)    NO DELETION IN /lm/ STEMS (ALL SOURCES):
        *hylm̱di*        [hɪlmd̥ɪ]        'conceal.PRET'        (cf. INF. *hylma* [hɪlma])

The last two consonants in the sequence [lmd̥] can hardly be considered more acceptable as a complex onset than those in (57b-c). An onset [md̥] violates the SSP and is worse in terms of sonority than the stop-stop and fricative-nasal sequences in (57). Itô is not totally explicit about the exact shape of the permissible complex onsets – she only assumes, as a mininal requirement, that only sequences of rising sonority can form a complex onset. This should automatically rule out [md̥] in (58) as a potential candidate. Moreover, we will see shortly other forms whose underlying sequence also ends in a nasal-stop sequence, but which are subject to obligatory cluster reduction. Sonority is therefore not the relevant factor here.

Variation already shows up in /r/+nasal stems. For my two informants, as well as Einarsson[48], /rm/ stems behave like /lm/ ones above and tolerate no simplification (59). Only Rögnvaldsson indicates the deletion of the initial /r/ in similar forms (60).

(59)    NO DELETION IN /rm/ STEMS (O, H, E):
        a. *verm̱di*        [vɛrmd̥ɪ]        'warm.PRET'        (cf. INF. *verma* [vɛrma])
        b. *ferm̱di*        [fɛrmd̥ɪ]        'load.PRET'        (cf. INF. *ferma* [fɛrma])
        c. *þyrm̱di*        [θɪrmd̥ɪ]        'spare.PRET'        (cf. INF. *þyrma* [θɪrma])

(60)    /r/ DELETION IN /rm/ STEMS (R):
        a. *þyṟmdi*        [θɪmd̥ɪ]        'spare.PRET'        (cf. INF. *þyrma* [θɪrma])
        b. *feṟmdist*        [fɛmd̥ɪst]        'load.PRET,MIDDLE'        (cf. INF. *ferma* [fɛrma])

With /rn/ stems, /r/-deletion is more frequent and occurs not only in Rögnvaldsson, who cites (61), but also in informant H's speech. H, however, considers that deletion is optional in this case (62). The possibility of /r/-dropping is also noted in Blöndal and Einarsson (p. 82) (62a).[49] Speaker O, unlike all the others, does not accept the /r/-less outputs (63).

(61)    /r/ DELETION IN /rn/ STEMS (R):
        *stiṟndi*        [stɪnd̥ɪ]        'glitter.PRET'        (cf. INF. *stirna* [stɪrna])

(62)    VARIABLE /r/ DELETION IN /rn/ STEMS (H, B, E):
        a. H,B,E    *stiṟndi*        [stɪ(r)nd̥ɪ]        'glitter.PRET'        (cf. INF. *stirna* [stɪrna])
        b. H        *spyṟndi*        [spɪ(r)nd̥ɪ]        'spurn.PRET'        (cf. INF. *spyrna* [spɪrna])

(63)    NO DELETION IN /rn/ STEMS (O):
        a. *stiṟndi*        [stɪrnd̥ɪ]        'glitter.PRET'        (cf. INF. *stirna* [stɪrna])
        b. *spyṟndi*        [spɪrnd̥ɪ]        'spurn.PRET'        (cf. INF. *spyrna* [spɪrna])

/r/ deletion in this context seems to be just a specific instantiation of a more general tendency toward the loss of rhotic articulations before certain consonants (Einarsson 1945; Rögnvaldsson 1989). Speaker O appears to lack this process, at least in the context of past forms, as he rejects the /r/-less pronunciations. I suspect that this follows from a variable that is independent from the behavior of clusters in preterit forms. But what is of interest to us is the variation observed in the domain of application of /r/-deletion. For Rögnvaldsson, it applies before /n/ and /m/ alike, whereas for speaker H and Einarsson it is restricted to /n/. I suggest that this distinction relates to the role of contrast in consonant deletion already noted for Hungarian and English: /r/ is more likely to delete before homorganic than non-homorganic nasals (/n/ vs. /m/), i.e. in the absence of contrast in place of articulation.

Let us now turn to stems ending in a cluster that includes an obstruent, with the following main categories: sonorant+obstruent, obstruent+sonorant, and

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[48]Blöndal does not cite the forms in (59) but it must be noted that he and Einarsson almost invariably agree in the pronunciations they propose.

[49]According to Blöndal /r/-deletion in (62a) applies only in some varieties. Einarsson notices the possibility of omitting the /r/ in the same form but fails to mention the existence of dialectal or individual variation.

fricative+stop. In all cases, if a consonant deletes, it is the obstruent; in the case of fricative+stop it is the stop. The main determining factor in the application of deletion appears to be the amount of contrast in manner of articulation between the obstruent and the other consonant in the stem. We also observe lexical effects and a substantial amount of interspeaker variation. So deletion is not determined by the position but by the nature of the consonants, as the deleted obstruent may be the first or the middle consonant in the cluster.

The stems whose final cluster comprises an obstruent and a nasal (in either order) show no variation across speakers or verbs: the obstruent invariably deletes. This is shown in (64) for nasal+stop stems (see also *kembdi* in (57b)), (65) for stop+nasal stems and (66) for fricative+nasal stems. In all cases the remaining nasal takes on the place of articulation of the deleted obstruent.

(64)    OBSTRUENT DELETION IN NASAL+STOP STEMS (ALL SOURCES):
    a. *hangdi*    [hauŋɖɪ]    'hang.PRET'    (cf. INF. *hanga* [hauŋga])
    b. *hringdi*   [hr̥iŋɖɪ]    'ring.PRET'    (cf. INF. *hringja* [hr̥iɲɟa])[50]
    c. *tengdi*    [tʰeiŋɖɪ]    'join.PRET'    (cf. INF. *tengja* [tʰeiɲɟa])
    d. *skenkti*   [sceiŋ̊tɪ]    'pour.PRET'    (cf. INF. *skenkja* [sceiɲ̊cʰa])

(65)    OBSTRUENT DELETION IN STOP+NASAL STEMS (ALL SOURCES):
    a. *gegndi*    [ɟeiɳɖɪ]    'obey.PRET'    (cf. INF. *gegna* [ɟɛgna])
    b. *rigndi*    [rɪɳɖɪ]    'rain.PRET'    (cf. INF. *rigna* [rɪgna])
    c. *signdi*    [sɪɳɖɪ]    'bless.PRET'    (cf. INF. *signa* [sɪgna])

(66)    OBSTRUENT DELETION IN FRICATIVE+NASAL STEMS (ALL SOURCES):
    a. *efndi*     [ɛmtɪ]    'carry.PRET'    (cf. INF. *efna* [ɛpna])
    b. *hefndi*    [hɛmtɪ]    'avenge.PRET'    (cf. INF. *hefna* [hɛpna])
    c. *nefndi*    [nɛmtɪ]    'call.PRET'    (cf. INF. *nefna* [nɛpna])
    d. *stefndi*   [stɛmtɪ]    'take a course.PRET'    (cf. INF. *stefna* [stɛpna])

The remaining stems show a substantial amount of variation in the preterit form. Those ending in a fricative+stop sequence – two stems in /-sk/ – have a strong tendency to lose the middle velar stop. For speaker H, retention of the /k/ is acceptable, though somewhat marginally, with one of the two verbs (67a). Einarsson also marks the stop as optional in this form. Speaker O (in agreement with Blöndal) omits the stop in both forms.

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(67)    VARIABLE STOP DELETION IN FRICATIVE+STOP STEMS:
    a. *æskti*    H,E    [ais(k)tɪ]    'wish.pret'    (cf. inf. *æskja* [aisca])
                 O, B    [aistɪ]
    b. *ræskti*    (All)    [raistɪ]    'clear the throat.pret' (cf. inf. *ræskja* [raisca])

Stems composed of an obstruent and a liquid show a split between speaker H on the one hand and speaker O, Blöndal, and Einarsson on the other hand. For the latter three sources, obstruent deletion can be considered optional next to a liquid. (A more pronounced tendency toward retention can be observed for informant O, as opposed to B and E). For obstruent+liquid stems, metathesis of the two consonants is also attested, besides obstruent deletion and retention of the whole cluster. A few illustrative examples are given below, for /l/+obstruent (68), obstruent+/l/ (69), and /r/+obstruent (70) combinations. Note that variable deletion or metathesis apply differently in different sources: for a given consonant sequence and a given speaker, deletion or metathesis may be felt as optional in some verbs, obligatory in other verbs and excluded in yet other verbs. Other speakers may split the data differently. I largely disregard the detailed behavior here but refer the reader to the appendix for the complete list of the forms I have obtained.[51] The reader should also observe that underlying velar stops undergo fricativization to /ɣ/ or /x/ for O, B, and E.[52] In addition, underlying /f/ surfaces as a voiced [v] except in word-initial position and preceding a voiceless consonant (simplifying somewhat, see Einarsson for more details). These fricativization and voicing processes will become relevant later in the discussion.

(68)    VARIABLE OBSTRUENT DELETION IN /L/+OBSTRUENT STEMS (O, B, E):
    a. *velgdi*    OBE    [vɛl(ɣ)ɖɪ]    'warm up.pret'    (cf. inf. *velgja* [vɛlɟa])
    b. *fylgdi*    OBE    [fɪl(ɣ)ɖɪ]    'follow.pret' (cf. inf. *fylgja* [fɪlɟa])
    c. *velkti*    BE    [vɛl̥(x)tɪ]    'soil.pret'    (cf. inf. *velkja* [vɛl̥ca])
               O    [vɛl̥xtɪ]

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[50]The [hr̥-] transcription is the one given in Einarsson; Halle & Clements write [hr-] and Rögnvaldsson [r̥-].

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[51]Relevant factors in the behavior of particular verbs certainly include frequency, register, and homophony with the past form of another verb. But I am not in a position to discuss this aspect of the data.

[52]Fricativization also optionally applies to /p/→ [f] for informant O (i,a-b), but I found no mention of this in Blöndal or Einarsson. Fricativization with labials is never obligatory and it seems to be blocked with certain verbs, like *verpti* in (i,c). The contrast between informant O and the others for the optional fricativization of labial stops is shown below. This process can probably be disregarded for the rest of the discussion.

(i)    a.    *skyrpti*    O [skɪr̥ptɪ] [skɪr̥ftɪ]    H [skɪr̥(p)tɪ]    'spit.PRET'
       b.    *skerpti*    O [skɛr̥ptɪ] [skɛr̥ftɪ]    B [skɛr̥(p)tɪ]    'sharpen.PRET'
       c.    *verpti*    O [vɛr̥ptɪ] *[vɛr̥ftɪ]    E [vɛr̥(p)tɪ]    'lay eggs.PRET'

    d. *skelfdi*    E    [skɛl(v)d̥ɪ]    'frighten.pret'    (cf. inf. *skelva* [skɛlva])

               OB    [skɛlvd̥ɪ]

(69)    VARIABLE OBSTRUENT DELETION AND METATHESIS IN OBSTRUENT+/l/ STEMS (O, B, E):

    a. *sigldi*    O    [sɪɣld̥ɪ]            'sail.PRET'

               E    [sɪ(ɣ)ld̥ɪ][53]                (cf. INF. *sigla* [sɪgla])

               B    [sɪɣld̥ɪ] [sɪlɣd̥ɪ]

    b. *yggldi*    B    [ɪlɣd̥ɪ]           'frown.PRET'

               O    [ɪld̥ɪ]                 (cf. INF. *yggla* [ɪg̊la])

    c. *efldi*    BE    [ɛl(v)d̥ɪ] [ɛvld̥ɪ]    'strengthen.PRET'

               O    [ɛl(v)d̥ɪ]             (cf. INF. *efla* [ɛpla])

    d. *skefldi*    BE    [skɛl(v)d̥ɪ] [skɛvld̥ɪ] 'form snowdrifts.PRET'

               O    [skɛld̥ɪ][54]             (cf. INF. *skefla* [skɛpla])

(70)    VARIABLE OBSTRUENT DELETION IN /r/+OBSTRUENT STEMS (O, B, E):

    a. *bergði*    BE    [bɛr(ɣ)ðɪ]    'taste.PRET'    (cf. INF. *bergja* [bɛrɟa])

               O    [bɛrɣðɪ]

    b. *merkti*    OBE    [mɛr̥(x)tɪ]    'mark.PRET'    (cf. INF. *merkja* [mɛr̥ca])

    c. *horfði*    OE    [hɔr(v)ðɪ]    'look.PRET'    (cf. INF. *horfa* [hɔrva])

    d. *þurfti*    OE    [θʏr̥(f)tɪ]    'need.PRET'    (cf. INF. *þurfa* [θʏrva])

               B    [θʏr̥tɪ]

    e. *verpti*    E    [vɛr̥(p)tɪ]    'lay eggs.PRET'    (cf. INF. *verpa* [vɛr̥pa])

               B    [vɛr̥tɪ]

               O    [vɛr̥ptɪ]

Let us now turn to speaker H, who is generally more inclined to deletion than speaker O. Obstruents are always dropped next to /l/ (71-72) but are variably retained after /r/, depending on the particular sequence and verb (73).[55] Notice that this speaker does not fricativize voiced stops, as shown in (73a-b).[56]

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[53]In the lexicon, Einarsson gives only the pronunciation [sɪɣld̥ɪ], but in the grammar (p.82), he explicitly states that the [ɣ] tends to be lost, as the [v] in (70c-d). I take this to mean that the [ɣ] is optional, which is also in accordance with Kress (1963: 41-42), who notes for *sigldi* the alternation between retention [sɪɣld̥ɪ], metathesis [sɪlɣd̥ɪ], and deletion [sɪld̥ɪ].

[54]For this verb, metathesis was explicitly rejected by informant O because it makes it homophonous with *skelfdi* in (68d). It is possible that in natural linguistic contexts, where the risk of confusion between the two verbs is almost inexistent, metathesis would not be unthinkable.

[55]Rögnvaldsson gives examples of obstruent deletion for /l/+obstruent (i,a-b), obstruent+/l/ (i,c-d), and /r/+obstruent (i,e-g) stems (see appendix for additional forms). But it cannot be determined on the basis of his data whether other verbs with the same segmental make-up behave differently and whether deletion is in all cases obligatory.

(71)    OBSTRUENT DELETION IN /l/+OBSTRUENT STEMS (H):

    a. *velgdi*    [vɛld̥ɪ]    'warm up.PRET'    (cf. INF. *velgja* [vɛlɟa])

    b. *fylgdi*    [fɪld̥ɪ]    'follow.PRET'    (cf. INF. *fylgja* [fɪlɟa])

    c. *velkti*    [vɛl̥tɪ]    'soil.PRET'    (cf. INF. *velkja* [vɛl̥ca])

    d. *skelfdi*    [skɛld̥ɪ]    'frighten.PRET'    (cf. INF. *skelva* [skɛlva])

(72)    OBSTRUENT DELETION IN OBSTRUENT+/l/ STEMS (H):

    a. *efldi*    [ɛld̥ɪ]    'strengthen.PRET'    (cf. INF. *efla* [ɛpla])

    b. *skefldi*    [skɛld̥ɪ]    'form snowdrifts.PRET'    (cf. INF. *skefla* [skɛpla])

    c. *sigldi*    [sɪld̥ɪ][57]    'sail.PRET'    (cf. INF. *sigla* [sɪgla])

    d. *yggldi*    [ɪld̥ɪ]    'frown.PRET'    (cf. INF. *yggla* [ɪg̊la])

(73)    VARIABLE OBSTRUENT DELETION IN /r/+OBSTRUENT STEMS (H):

    a. *bergði*    [bɛr(g)ðɪ]    'taste.PRET'    (cf. INF. *bergja* [bɛrɟa])

    b. *ergði*    [ɛrgðɪ]    'tease.PRET'    (cf. INF. *ergja* [ɛrɟa])

    c. *merkti*    [mɛr̥tɪ]    'mark.PRET'    (cf. INF. *merkja* [mɛr̥ca])

    d. *verpti*    [vɛr̥tɪ]    'lay eggs.PRET'    (cf. INF. *verpa* [vɛr̥pa])

    e. *skyrpti*    [skɪr̥(p)tɪ]    'spit.PRET'    (cf. INF. *skyrpa* [skɪr̥pa])

    f. *þurfti*    [θʏr̥tɪ]    'need.PRET'    (cf. INF. *þurfa* [θʏrva])

    g. *horfði*    [hɔrðɪ]    'look.PRET'    (cf. INF. *horfa* [hɔrva])

The data in (67)-(73) display a lot of variation, but the absence of deletion is widely attested, against Itô's predictions. In most cases where the three-consonant cluster surfaces intact, the last two consonants would form an onset with a high degree of markedness, e.g. [ɣð], [vð], [ld̥], [ɣd̥], [gð], [pt]. Some, like [ld̥], radically violate the SPP. I believe that consonant deletion in Icelandic is not syllabically-driven.[58] The same conclusion is reached by Gibson (1997), who brings as evidence

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(i)    Stems composed of an obstruent and a liquid (R):

    a. *fylgdi*    [fɪltɪ]    *'follow*.PRET'    (cf. INF. *fylgja* [fɪlca])

    b. *hvolfdi*    [kʰvɔltɪ]    'capsize.PRET'    (cf. INF. *hvolfa* [kʰvɔlva])

    c. *sigldi*    [sɪltɪ]    'sail.PRET'    (cf. INF. *sigla* [sɪkla])

    d. *skefldi*    [skɛltɪ]    'form snowdrifts.PRET'    (cf. INF. *skefla* [skɛpla])

    e. *skyrpti*    [skɪr̥tɪ]    'spit.PRET'    (cf. INF. *skirpa* [skɪr̥pa])

    f. *erfði*    [ɛrðɪ]    'inherit.PRET'    (cf. INF. *erfa* [ɛrva])

    g. *þurfti*    [θʏr̥tɪ]    'need.PRET'    (cf. INF. *þurfa* [θʏrva])

[56]Speaker H deletes the stop in examples like (72c), but he mentioned that, if a segment had to surface there, it would sure be a stop [g] and not a fricative, as for speaker O, B and E (69a).

[57]According to Helgason (1993), [sɪld̥ɪ] is the only natural pronunciation of this verb. Compare (72c) with (69a) above.

[58]Note that this conclusion weakens Vennemann's (1972) argument for the syllable (see section 1.1.1). Vennemann claimed that the introduction of the syllable simplified the phonology of Icelandic to the extent that numerous processes in this language refered to syllable boundaries.

Einarsson's pronunciations for *vermdi* (59a) and *sigldi* (69a), as well as cases of word-final clusters which I do not discuss here. However, she does not suggest an alternative solution, nor does she provide empirical generalizations. The behavior of these past forms is indeed quite complex, but some of the tendencies in deletion processes noticed in the other patterns examined in this chapter can go a long way toward explaining the Icelandic process of consonant deletion. These are: the role of contrast and the special status of stops, extended to non-strident fricatives. The SSP also appears to play a subsidiary role. Let us examine each of these factors.

First, it must be noted that consonant deletion does not take place, at least never obligatorily, in word-internal two-consonant clusters, that is when each consonant is flanked by a vowel. In this case the basic requirement that each consonant be adjacent to a vowel is met and there is no need for a repair strategy. Deletion occurs primarily in three-consonant sequences, when this requirement is violated. This follows from our first generalization, repeated below.

| | |
|---|---|
| *Generalization 1*: | Consonants want to be adjacent to a vowel, and preferably followed by a vowel. |

Let us now look at the type of consonants that delete. Apart from the particular case of /r/ before a nasal (60)-(62), the only consonants that delete are stops and the fricatives [f, v, x, ɣ] (the latter two only for the speakers that fricativize velar stops, i.e. O, B, and E). These segments contrast with nasals and liquids, which are stable, even in cluster-medial position. This explains the retention of the full cluster with /lm/ stems, for instance in (58). The deletion of stops constitutes by now a familiar generalization, as we have seen other examples of the greater propensity for stops to be dropped. I believe that the similar behavior of [f, v, x, ɣ] can be interpreted as an extension of the special status of stops. These segments may be classified as non-strident fricatives. Their frication noise is much weaker than for strident fricatives, which makes them resemble stops from the point of view of the cues present during the closure. See chapter 3 for a discussion of acoustic cues and perceptual motivations for the generalizations proposed in this chapter. The basic split among obstruents is usually taken to be between stops and fricatives, based on the presence or absence of frication noise during the closure. I suggest that another possible split distinguishes between strident and non-strident obstruents, the latter being more likely to delete and trigger epenthesis than the former. So I take the greater vulnerability of non-strident fricatives in Icelandic to follow from a modified

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The two processes he cites is vowel lengthening in stressed position and cluster simplification. If the latter is not in fact syllable-dependent, other processes should be put forward for the argument to go through.

version of generalization 2 concerning the special status of stops in deletion and epenthesis, which may also include non-strident fricatives.

| | |
|---|---|
| *Generalization 2*: (modified) | Non-strident obstruents, more than other consonants, want to be adjacent to a vowel, and preferably followed by a vowel. |

This argument, however, has to be completed with a note concerning the status of /s/, the only strident fricative in Icelandic. The preterit forms presented in this section do not allow us to draw firm conclusions about the behavior of /s/, as it does not appear in all the relevant positions in stem-final clusters. The only strident fricatives are found in /-sk/ stems, and we have seen that it is the stop that deletes. But there are no liquid+/s/ or nasal+/s/ stems.[59] A look at the behavior of /s/ in other contexts, however, clearly suggests that it is more resistent than non-strident fricatives and attests to its greater strength in interconsonantal position. First, there are stems that end in /rst/ and /lsk/ sequences, like those in (74), that is exactly of the liquid+obstruent+stop type found in preterit forms and that are subject to cluster reduction through deletion of the obstruent. Yet, the medial /s/ never deletes in these forms. In -*rst* stems it is rather the initial /r/ that may be dropped, as noticed above about /r/+nasal stems (60)-(62). As /r/ never deletes before obstruents other than /s/ (70, 73), its behavior here suggests that it is weaker than /s/, that is less resistent to deletion, but stronger than non-strident obstruents.

(74)    NO DELETION OF /s/ IN INTERCONSONANTAL POSITION:
    a. *þyrsta* [θɪ(ɾ̥)sta] 'get thirsty.INF'    *þyrsti* [θɪ(ɾ̥)stɪ] 'get thirsty.PRET'
    b. *byrsta* [bɪ(ɾ̥)sta] 'scorn.INF'    *byrsti* [bɪ(ɾ̥)stɪ] 'scorn.PRET'
    c. *elska* [ɛlska] 'love.INF'    *elskaði* [ɛlskaðɪ] 'love.PRET'

The stability of /s/ is also apparent in superlative forms of adjectives obtained by the addition of the suffix -*stur*. When added to stems ending in a consonant, a three-consonant cluster of the type consonant+obstruent+stop is created. Again, the medial /s/ never deletes, unlike stops in identical or similar contexts in preterit forms:

(75)    NO DELETION OF /s/ IN THE SUPERLATIVE SUFFIX -*stur*:
    a. *þynnstur*    [θɪnstʏɾ̥]    'thinnest'    (compare *skenkti* [sceiŋtɪ] (64d))
    b. *grennstur*    [grɛnstʏɾ̥]    'most slender'
    c. *mýkstur*    [mixstʏɾ̥]    'smoothest'

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[59]The stems I have seen of that sort take the /-aði/ preterit suffix, which is of no interest here, e.g. INF. *dansa* 'dance', PRET. *dansaði*.

Finally, Rögnvaldsson and Einarsson both provide long and systematic lists of cases of consonant deletion. Interestingly, both fail to provide a single example of /s/ deletion. This further supports the distinct status enjoyed by /s/ as opposed to non-strident fricatives.

Consider now the contexts in which non-strident obstruents delete. We observe a clear hierarchy based on the amount of contrast in manner of articulation between the obstruent and the adjacent consonant in the stem. As noted in the section on Hungarian, I use the major class features proposed by Clements (1990) to distinguish among consonants. The feature specifications are repeated from (32) above. In addition, obstruents are distinguished by the feature [strident].

(32)  CLEMENTS'S (1990) MAJOR CLASS FEATURES:

|             | Obstruents | Nasals | Liquids | Glides |
|-------------|------------|--------|---------|--------|
| Sonorant    | –          | +      | +       | +      |
| Approximant | –          | –      | +       | +      |
| Vocoid      | –          | –      | –       | +      |

The specifications in (32) allow us to establish a hierarchy among consonants in the degree of contrast they display with obstruents. Glides contrast the most with obstruents (contrast in [vocoid]), liquids show less contrast (contrast in [approximant]), and nasals still less (contrast in [sonorant]). A contrast in stridency between two obstruents is independent from this hierarchy.

Recall that speaker H systematically deletes (non-strident) obstruents when the adjacent segment in the stem is a nasal (64)-(66) or /l/ (71)-(72), but variably retains them next to /r/ (73) or /s/ (67). Speaker O, Blöndal, and Einarsson also obligatorily delete non-strident obstruents next to a nasal, but optionally retain them next to both /r/ and /l/ (68)-(70). After /s/, speaker O and B delete the stop but Einarsson optionally keeps it (67). I interpret these results in the following way. First, I consider /r/ to be more sonorous than /l/, as is standardly assumed; I take /r/ to be a glide, specified as [+vocoid], whereas /l/ is a liquid [-vocoid, +approximant].[60] The generalizations concerning obstruent deletion can now be stated as follows. The likelihood that a non-strident obstruent is retained correlates with the amount of contrast in manner of articulation between it and the adjacent consonant within the stem. With only a contrast in [sonorant] (nasals), the obstruent is obligatorily deleted in all speakers; with a larger contrast in [approximant] (/l/), the obstruent is variably retained in a subset of speakers (O, B, E) but still systematically deleted in others (H); with a maximal contrast in [vocoid] (/r/), all speakers allow the optional retention of

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[60]I will argue for the same specifications in French in the following chapter.

the obstruent. Obstruents that contrast in [strident] with another obstruent are generally variably maintained. The main difference between H and O, B, E lies in the more stringent conditions imposed by H on the licensing of non-strident obstruents: whereas a contrast in [approximant] is sufficient for O, B, E to maintain an obstruent, H requires a bigger contrast in [vocoid]. This follows from the fourth generalization.

*Generalization 4:*  Consonants that are relatively similar to a neighboring segment want to be adjacent to a vowel, and preferably followed by a vowel.

Contrast alone accounts for obstruent deletion in consonant+obstruent stems. Something more has to be said, however, about obstruent+sonorant stems. These differ from consonant+obstruent ones in two ways. First, the initial obstruent follows a vowel and deletion is unexpected in a position that is adjacent to a vowel. Second, obstruent+/l/ stems display variable metathesis in preterit forms, for speaker O, B, and E. Thus [ɣl] / [vl] alternate with [lɣ] / [lv] (metathesis) and [l] (deletion) in (76=69a, 69c).

(76)  DELETION AND METATHESIS IN OBSTRUENT+/l/ STEMS:
  a.  *sigldi*  O   [sɪɣld̥ɪ]          'sail.PRET'        (cf. INF. *sigla* [sɪgla])
            E   [sɪ(ɣ)ld̥ɪ]
            B   [sɪɣld̥ɪ] [sɪlɣd̥ɪ]
  b.  *efldi*   BE  [ɛl(v)d̥ɪ] [ɛvld̥ɪ]  'strengthen.PRET'  (cf. INF. *efla* [ɛpla])
            O   [ɛl(v)d̥ɪ]

I suggest that to account for the behavior of these stems contrast operates in conjunction with the SSP, repeated below. The addition of the preterit suffix to them creates an obstruent+sonorant+obstruent cluster which violates the SSP and is unacceptable. Metathesis is motivated by the desire to avoid the SSP violation, by putting the obstruent rather than the sonorant in cluster-medial position.

*Sonority Sequencing Principle:*   Sonority maxima correspond to sonority peaks.

Metathesis, however, is unavailable in onstruent+nasal stems for all speakers and obstruent+/l/ ones for speaker H. This follows from the role of contrast. Would metathesis apply, the SSP violation would be avoided but the resulting sequence would not display a sufficient amount of contrast. Therefore metathesis cannot save these clusters and deletion remains the only solution. Nasals and obstruents contrast only in the feature [sonorant], which is for no speakers sufficient to license non-strident obstruents. Consider the examples in (77=65a, 66a). The faithful output

*[ɹeignd̥ɪ] in (77a) violates the SSP; the metathesized form *[ɹeingd̥ɪ] fails to meet the contrast requirement; hence deletion [ɹeind̥ɪ]. /l/+obstruent sequences contrast in [approximant]. This contrast is large enough for speaker O, B, and E to license the obstruent, hence metathesis in (76). But speaker H requires a still bigger contrast, one in [vocoid], so forms like [ɛvldɪ] (76b) are unacceptable for this speaker with respect to contrast, which explains the absence of metathesis and the obligatoriness of obstruent deletion, in both /l/+obstruent (71) and obstruent+/l/ (72).

(77)    DELETION IN OBSTRUENT+NASAL STEMS:
    a.  *gegndi*    [ɹeiŋdɪ]    'obey.PRET'    (cf. INF. *gegna* [ɹɛgna])
    b.  *efndi*    [ɛmd̥ɪ]    'carry.PRET'    (cf. INF. *efna* [ɛb̥na])

    This account of deletion and metathesis in preterit forms raises one obvious question, though: Why are [sɪɣldɪ] (76a) and [ɛvldɪ] (76b) acceptable at all for O, B, and E if they violate the SSP? Here I rely on Helgason's (1993) discussion of the behavior of voiced fricatives in Icelandic. Icelandic has on the surface three such fricatives: [v], [ð], and [ɣ]. [ɣ] originates from a process of fricativization of [g], which applies in the context of the preterit suffix next to a liquid [r,l]. This process is active for speaker O, as well as Einarsson and Blöndal, but is does not apply in speaker H's speech. According to Helgason (1993: 31-32), these voiced fricatives are subject to a variable approximantization rule when preceded by a voiced segments and followed by any segment. The approximant versions of these fricatives are noted [ʋ], [ð̞], and [ɰ]. The alternation between fricative and approximant articulations for these sounds is not exceptional from a crosslinguistic point of view. Ohala (1983: 198), for instance, notes that "the phonetic symbols [v, β, ð, ɣ] are often used for either fricatives or frictionless continuants". Lavoie (2000) also provides references and arguments pointing to the same conclusion. Examples of approximantization from Helgason (1993: 32) are provided below:[61]

(78)    APPROXIMANTIZATION OF VOICED FRICATIVES:
                     Citation form    Spoken form
    a.  *segðu*    [seiɣðɤ]    [seiɰð̞ɤ]    'say+IMP'
    b.  *hugmynd*    [hʏɣmɪnt]    [hʏɰmɪnt]    'idea'
    c.  *töfrandi*    [tʰœvɾantɪ]    [tʰœʋɾantɪ]    'charming'

    If [sɪɣldɪ] and [ɛvldɪ] should really be transcribed [sɪɰldɪ] and [ɛʋldɪ], we get no sonority violation. [ɰ] and [ʋ] should probably be considered more sonorous than laterals: Ladefoged & Maddieson (1996) treat [ɰ] and [ʋ] together in a section on vowel-like consonants in the chapter on vowels (even though they consider that of these two only [ɰ] is properly a glide). Now, this proposal raises the additional question of why this approximantization process is not used by speaker H, or with fricative+nasal stems by any of the sources. We would then get pronunciations like *[ɛʋndɪ] *efndi* in (77), which is on the surface conform to both the SSP and the minimal amount of contrast. This problem would be solved if contrast had to be computed on the "deep" fricative specifications of these consonants rather than the "surface" approximant ones, while sonority would be a more surfacy constraint. This is not a trivial issue, especially in an output-oriented framework like Optimality Theory, but my understanding of approximantization and sonority in Icelandic is too limited to proceed to a thorough and meaningful discussion of this problem, which I leave for future work.

    To sum up this long section on Icelandic and leaving aside the problem mentioned in the previous paragraph, I have suggested that consonant deletion in preterit forms of weak verbs is not syllabically-driven but can be accounted for in large part by some of the sequential principles I propose in this chapter: 1) the avoidance of consonants that are not adjacent to a vowel, 2) the greater vulnerability of stops, to which we can add non-strident fricatives, to deletion, 3) the inhibiting effect of contrast with adjacent segments on consonant deletion, and 4) the Sonority Sequencing Principle.

### 1.3. CONCLUSIONS

    In this chapter I have argued that approaches based on syllable well-formedness should be rejected in accounts of consonant deletion, vowel epenthesis, and vowel deletion. This conclusion is supported in large part by the analysis of several deletion patterns for which syllable-driven accounts appear untenable. An additional problematic case – the French schwa – will be reviewed in the following chapter. These patterns rather reveal a number of sequential generalizations, which the rest of the dissertation will account for and further illustrate. The argument

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[61]The approximants [ʋ], [ð̞], and [ɰ], to which we have to add [j], are themselves subject to deletion in various contexts, notably in preconsonantal position (Árnason 1980: 218; Rögnvaldsson 1989: 52; Helgason 1993: 38-40). This is also in line with crosslinguistic tendencies, as the loss of these segments is a frequent historical process. Examples from Helgason follow:
(i)            Citation form    Spoken form
    a.  *dagblaði*    [taɣplaðɪ]    ([tauplað̞ɪ])    [ta:plaðɪ]    'newspaper+DAT'
    b.  *sagði*    [saɣðɪ]    ([sauð̞ɪ])    [saðɪ]    'say+PRET'
    c.  *afmæli*    [avmailɪ]    ([aumailɪ])    [am:ailɪ]    'birthday'
    d.  *eðlilega*    [ɛðlilɛɣa]    ([ɛð̞lilɛɰa])    [ɛlilɛɣa]    'naturally'
It is unclear at this point how approximantization affects and interacts with consonant deletion in preterit forms.

against reference to the syllable in deletion and epenthesis processes was completed by discussions suggesting that it is also insufficient, as the necessity of independent principles has never been questioned, and unnecessary, to the extent that patterns successfully accounted for in syllabic terms are amenable to an equally simple and insightful sequential analysis.

**APPENDIX:**
**PRETERIT FORMS OF ICELANDIC WEAK VERBS**

    This appendix gives all the forms I obtained from my informants and various written sources for the Icelandic weak verbs whose preterit is formed by direct attachment of *-di/-ti/-ði* to the stem.

*Sources*:

| | | | | |
|---|---|---|---|---|
| B | Blöndal (1920) | | E | Einarsson (1945) |
| O | Informant O | | H | Informant H |
| R | Rögnvaldsson (1989) | | H&C | Halle & Clements (1983) |

Note 1:   Einarsson (1945) is composed of a grammar and a lexicon. Almost all the data below are taken from the lexicon, in which every form is given with its pronunciation. In some cases, however, I have found additional forms or observations on the pronunciation of certain verbs in the grammar; these are also indicated, followed by the page number from which they are taken.

Note 2:   Einarsson and Blöndal sometimes provide two pronunciations, which are supposed to reflect dialectal variation. In such cases I give both forms, but since it is not always clear what dialectal area they cover, I do not try to specify it.

Note 3:   "---" indicates that the relevant form cannot be found in the given source.

Note 4:   For nasal+stop and obstruent+nasal stems, I have not checked the pronunciations in Blöndal (1920), except for *efndi*, because there does not seem to be any variation on these forms.

| | **B** | **E** | **O** | **H** | **R** | **H&C** |
|---|---|---|---|---|---|---|
| Nasal+Stop stems: | | | | | | |
| *hangdi* 'hang' | ? | [hauŋɖı] | — | [hauŋ̊ɖı] | — | — |
| *hengdi* 'hang' | ? | [heiŋɖı] | [heiŋɖı] | [heiŋɖı] | [heiŋɖı] | — |
| *hringdi* 'ring' | ? | [hr̥iŋɖı] | [hr̥iŋɖı] | [hr̥iŋɖı] | [r̥iŋɖı] | [hriŋɖı] |
| *kembdi* 'comb' | ? | [cʰɛmɖı] | [cʰɛmɖı] | [cʰɛmɖı] | [cʰɛmɖı] | — |
| *skenkti* 'pour' | ? | [sceiɲtʰı] [sceiɲtı] | [sceiɲtı] | [sceiɲ̊tı] | — | — |
| *sprengdi* 'explode' | ? | [spreiŋɖı] | [spreiŋɖı] | [spreiŋɖı] | — | — |
| *tengdi* 'join' | ? | [tʰeiŋɖı] | [tʰeiŋɖı] | [tʰeiŋɖı] | — | — |

Obstruent+Nasal stems:

| | | | | | | |
|---|---|---|---|---|---|---|
| *signdi* 'bless' | ? | — | [sɪŋɟɪ] | [sɪŋɟɪ] | — | [sɪŋɟɪ] |
| *gegndi* 'obey' | ? | — | [ɟeiŋɟɪ] | [ɟeiŋɟɪ] | — | — |
| *rigndi* 'rain' | ? | [rɪŋɟɪ] | [rɪŋɟɪ] | [rɪŋɟɪ] | [rɪŋɟɪ] | — |
| *efndi* 'carry' | [ɛmɟɪ] | [ɛmɟɪ] | [ɛmɟɪ] | [ɛmɟɪ] | [ɛmɟɪ] | — |
| *hefndi* 'avenge' | ? | [hɛmɟɪ] | [hɛmɟɪ] | [hɛmɟɪ] | — | — |
| *nefndi* 'call' | ? | [nɛmɟɪ] | [nɛmɟɪ] | [nɛmɟɪ] | — | — |
| *stefndi* 'take a course' | ? | [stɛmɟɪ] | [stɛmɟɪ] | [stɛmɟɪ] | — | — |

Liquid+Nasal stems:

| | | | | | | |
|---|---|---|---|---|---|---|
| *fermdi(st)* 'confirm (a child); load' | — | [fɛrmɟɪ] | [fɛrmɟɪ] | [fɛrmɟɪ] | [fɛmɟɪst] | — |
| *vermdi* 'warm' | — | [vɛrmɟɪ] | [vɛrmɟɪ] | [vɛrmɟɪ] | — | — |
| *þyrmdi* 'spare' | ? | — | ? | [θɪrmɟɪ] | [θɪmɟɪ] | — |
| *hylmdi* 'conceal' | — | *hylmdi* p.82 | [hɪlmɟɪ] | [hɪlmɟɪ] | — | — |
| *stirndi* 'glitter' | [stɪ(r)nɟɪ] | *sti(r)ndi* p.82 | [stɪrnɟɪ] | [stɪ(r)nɟɪ] | [stɪnɟɪ] | — |
| *spyrndi* 'spurn' | — | — | [spɪrnɟɪ] | [spɪ(r)nɟɪ] | — | — |

Non-nasal consonant+Obstruent stems:

| | | | | | | |
|---|---|---|---|---|---|---|
| *bergði* 'taste' | [bɛr(ɣ)ðɪ] | [bɛr(ɣ)ðɪ] | [bɛrɣðɪ] | [bɛr(g)ðɪ] | — | — |
| *byrgði* 'lock up' | [bɪr(ɣ)ðɪ] | [bɪr(ɣ)ðɪ] p.82 | [bɪrɣðɪ] | [bɪr(g)ðɪ] | — | — |
| *ergði* 'tease' | [ɛr(ɣ)ðɪ] | — | [ɛrɣðɪ] | [ɛrgðɪ] | — | [ɛrðɪ] |
| *syrgði* 'mourn' | [sɪrðɪ] | [sɪrðɪ] / [sɪrɣðɪ] | [sɪrɣðɪ] | [sɪr(g)ðɪ] | — | — |
| *fylgdi* 'follow' | [fɪl(ɣ)ɟɪ] | [fɪl(ɣ)ɟɪ] | [fɪl(ɣ)ɟɪ] | [fɪlɟɪ] | [fɪlɟɪ] | [fɪɬɟɪ] |
| *svelgdi* 'swallow' | [svɛl(ɣ)ɟɪ] | [svɛl(ɣ)ɟɪ] | [svɛlɟɪ] | [svɛlɟɪ] | — | — |
| *telgdi* 'whittle' | [tʰɛlɣɟɪ] / [tʰɛɣlɟɪ] | [tʰɛlɣɟɪ] / [tʰɛɣlɟɪ] | [tʰɛlɣɟɪ] | [tʰɛlɟɪ] | — | — |
| *velgdi* 'warm up' | [vɛl(ɣ)ɟɪ] | [vɛl(ɣ)ɟɪ] | [vɛl(ɣ)ɟɪ] | [vɛlɟɪ] | — | — |

| | | | | | | |
|---|---|---|---|---|---|---|
| *belgdi* 'inflate' | ? | — | ? | ? | [bɛlɟɪ] | — |
| *merkti* 'mark' | [mɛr̥(x)tɪ] | [mɛr̥(x)tɪ] | [mɛr̥(x)tɪ] | [mɛrtɪ] | — | |
| *styrkti* 'help' | [stɪr̥(x)tɪ] | [stɪr̥(x)tɪ] | [stɪr̥xtɪ] | [stɪr̥tɪ] | — | |
| *fylkti* 'array' | — | [fɪl̥tɪ] / [fɪl̥xtɪ] | [fɪl̥xtɪ] | [fɪl̥tɪ] | — | |
| *velkti* 'soil' | [vɛl̥(x)tɪ] | [vɛl̥(x)tɪ] | [vɛl̥xtɪ] | [vɛl̥tɪ] | — | |
| *verpti* 'lay eggs' | [vɛr̥tɪ] | [vɛr̥(p)tɪ] | [vɛr̥ptɪ] | [vɛr̥tɪ] | — | [vɛr̥tɪ] |
| *skerpti* 'sharpen' | [skɛr̥(p)tɪ] | — | [skɛr̥ptɪ] | [skɛr̥ftɪ] | [skɛr̥tɪ] | — |
| *skyrpti* 'spit' | — | — | [skɪr̥ptɪ] | [skɪr̥ftɪ] | [skɪr̥(p)tɪ] | [skɪr̥tɪ] |
| *erfði* 'inherit' | [ɛr(v)ðɪ] | [ɛr(v)ðɪ] | [ɛrvðɪ] | [ɛrðɪ] | [ɛrðɪ] | — |
| *horfði* 'look' | — | [hɔr(v)ðɪ] | [hɔr(v)ðɪ] | [hɔrðɪ] | [hɔrðɪ] | |
| *hvolfdi* 'capsize' | — | [hwɔlɟɪ] / [kʰvɔlɟɪ] | [kʰvɔlvɟɪ] | [kʰvɔlɟɪ] | [kʰvɔlɟɪ] | |
| *skelfdi* 'frighten' | [skɛlvɟɪ] | [skɛl(v)ɟɪ] p.82 | [skɛlvɟɪ] | [skɛlɟɪ] | — | |
| *þurfti* 'need' | [θɪr̥tɪ] | [θɪr̥(f)tɪ] | [θɪr̥(f)tɪ] | [θɪr̥tɪ] | [θɪr̥tɪ] | — |
| *æskti* 'wish' | [aistɪ] / [ais(k)tɪ] | [aistɪ] | [aistɪ] | [ais(k)tɪ] | — | |
| *ræskti* 'clear the throat' | [raistɪ] | — | [raistɪ] | [raistɪ] | — | [raisti] |

Obstruent+Liquid stems:

| | | | | | | |
|---|---|---|---|---|---|---|
| *yggldi* 'frown' | [ɪlɣɟɪ] | — | [ɪɬɟɪ] | [iɬɟɪ] | [ɪlɟɪ] | [ɪɬɟɪ] |
| *sigldi* 'sail' | [sɪɣldɪ] / [sɪlɣɟɪ] | [sɪɣldɪ] | [sɪɣldɪ] | [sɪldɪ] | [sɪldɪ] | —   p.82: (ɣ) |
| *efldi* 'strengthen' | [ɛl(v)ɟɪ] / [ɛvlɟɪ] | [ɛvlɟɪ] / [ɛl(v)ɟɪ] | [ɛl(v)ɟɪ] | [ɛlɟɪ] | [ɛlɟɪ] | |
| *skefldi* 'form snowdrifts' | [skɛlvɟɪ] / [skɛvlɟɪ] | p.14: vl/lv; p.82: (v) | [skɛlɟɪ] | [skɛlɟɪ] | [skɛlɟɪ] | |

**Chapter 2**

**<u>SCHWA DELETION AND EPENTHESIS IN FRENCH</u>**

French has a famous and notoriously complex pattern of alternation between Ø and schwa. Consider the following pair:

(1)   ALTERNATION BETWEEN ə AND Ø:
a.   *carafe de vin*        [karafd<u>ə</u>vɛ̃]        'carafe of wine'
b.   *pichet de vin*        [piʃɛdvɛ̃]        'pitcher of wine'

The crucial difference between (1a) and (1b) lies in the realization of the preposition *de*, which surfaces as [də] in (1a) and as [d] in (1b). This type of alternation based on the presence or absence of [ə] – generally called *e muet* 'mute e' or schwa[1] (even when it does not have, when it surfaces, the phonetic value attributed to schwa in the IPA)[2] – is omnipresent in French and is subject to numerous factors: segmental, morphological, syntactic, prosodic and rhythmic, stylistic, sociolinguistic, etc. (see Verluyten 1988 for a summary). A general account of the distribution of this vowel represents a seemingly unsurmountable challenge.

What everybody agrees on is that schwa surfaces to break up or avoid complex consonant clusters. Analyses mainly fall into two groups: sequential and prosodic. They all fall short of accounting for the complete range of facts, but I will argue that the prosodic approach is doomed to failure and that substantial progress may only be obtained within a sequential one.

This chapter is organized as follows. I first lay out my assumptions about the underlying status of schwa and synthesize the data that I believe any theory of the distribution of this vowel has to account for. A presentation and evaluation of the various syllabic analyses follow. Upon the conclusion that the syllabic approach is empirically inadequate, I propose in the last section a number of sequential

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[1]Other terms used to refer to this vowel include: *e* caduc, *e* instable, *e* féminin, *e* français, *e* svarbhaktic, *e* bifide, *e* semi-muet, *e* intermittent,  etc. See Walter (1976, 1990) for more attested terms, up to the Renaissance, and for a short history of these denominations.
[2]When it surfaces, this vowel generally has the value [œ] or [ø] in the dialect I am concerned with here (see below; e.g. Dell 1973/1980/1985; Morin 1978), as well as in my own Québec French variety (Martin 1998). But I will retain the symbol [ə], which is the traditional one, to distinguish this vowel from the stable vowels /œ/ and /ø/.

generalizations that I believe adequately characterize the main segmental factors involved in the behavior of schwa.  These are precisely the generalizations that were established in the previous chapter, which gain additional support from a process of vowel deletion and vowel epenthesis. Note that the data provided here all come from what could be characterized as the speech of educated urban speakers from Northern France, in particular Paris.[3]

**2.1. BASIC FACTS**

**2.1.1. THE UNDERLYING STATUS OF SCHWA**

The underlying status of schwa has generated a substantial body of literature. Are we dealing with vowel epenthesis or vowel deletion?  What is the domain of application of the process of schwa deletion/epenthesis? My position on these issues departs from what is assumed in most previous analyses, at least in generative phonology. So it is not useless to discuss it here, especially for those readers who are familiar with the topic. Notice however that the specific division of work I assume between epenthesis and deletion is not absolutely crucial for the proposals I am going to make about the segmental factors in the distribution of schwa.

First, I define schwa as a vowel that alternates with Ø in the same lexical or morphological context. For example, the word *demain* 'tomorrow' may surface as [dmɛ̃] or [d<u>ə</u>mɛ̃], and the adverbial suffix *-ment* comes with or without [ə], depending on the adjective it attaches to, e.g. *fortement* 'strongly' [fɔrt<u>ə</u>mã] vs. *sottement* 'foolishly' [sɔtmã]. This vowel is systematically denoted [ə], whatever its precise phonetic value is. I exclude from the domain of schwa all morpheme-internal vowels that always or never surface in contemporary French, including those that derive from historic schwas. I assume that these vowels, usually denoted with <e> in the orthography, have been reanalyzed as stable /œ/'s or have disappeared from the underlying representation. Representative examples are 1) *squelette* 'skeleton', which is always pronounced [skœlɛt] *[sklɛt] and for which I adopt the underlying representation /skœlɛt/, and 2) *samedi* 'Saturday', systematically pronounced

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[3]Unlike other authors, I do not use the term Standard French, which has a normative flavor I consider irrelevant here. If it is true that educated speakers from Paris and other Northern cities ultimately determine much of the norm, we cannot safely claim that everything they say corresponds to what would generally be considered normative. For an essential discussion of the notion of Standard French and other empirical problems in French phonology, see Morin (1987a, 2001).

[samdi] *[sam<u>ə</u>di] and which contains no medial vowel in its underlying representation /samdi/).[4]

Second, I consider that the underlying status of schwa is not uniform. Schwa appears in two broad morphological contexts: at morpheme/word junctures, and morpheme-internally. I believe that all schwas found at morpheme and word boundaries are epenthetic, whereas morpheme-internal ones are underlying.[5] The distribution of schwa vs. Ø at boundaries depends on independent phonological and morphological conditions, and vowels do not have to be posited underlyingly.[6] But morpheme-internal schwas, which are found only in the first syllable of polysyllabic morphemes (e.g. *demain* above), are unpredictable and cannot be epenthetic.[7] Morin (1974) suggests this combination of underlying and epenthetic schwas but does not

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[4]I also exclude from my discussion the so-called [ə]-[ɛ] alternation. Three cases arise in modern French: [ɛ] alternates with Ø (i), with [œ] (which I analyze as a stable /œ/) (ii), or with a deletable schwa (according to the definition adopted here) (iii).

(i) *appelle* 'call.PRESENT' [apɛl]          vs.          *appeler* 'call.INFINITIVE' [aple]
(iii) *pèse* 'weigh.PRESENT' [pɛz]          vs.          *peser* 'weigh.INFINITIVE' [pœze]
(iii) *mène* 'lead.PRESENT' [mɛn]          vs.          *mener* 'lead.INFINITIVE' [m(ə)ne]

I follow Morin (1988), who convincingly argues that these alternations are not phonological in contemporary French but are to be derived by allomorphy. See also Morin (1978, 1998).

[5]I am not concerned here with the exact representation of this vowel: as /œ/ with a special diacritic marking it as deletable (e.g. Morin 1978), an empty/featureless nuclear position (e.g. Anderson 1982; Withgott 1982; Charette 1991; Noske 1993), or a floating vowel (e.g. Hyman 1985; Tranel 1987a, Encrevé 1988).

[6]One may legitimately suspect that there are arguments for positing underlying schwas at morpheme boundaries (other than tradition and orthography). Dell (1973/1980/1985) is the author that most explicitly and most carefully presents the case for underlying schwas. His arguments are in large part theory-internal (final schwas in non-clitic words are posited to protect the preceding consonant from deletion), empirical arguments being very limited (mainly the behavior of schwa before h-aspiré words and the suffix *-rions/-riez* (1st person plural forms of the conditional present tense). Morin (1978) and Tranel (1981) convincingly argue against these theoretical and empirical arguments. Tranel, however, retains underlying schwas in clitics (*te, que, de, me, ne, se, ce, le*), for the reason that a schwa is pronounced in the citation form of these words. I believe this to be an unnecessary stipulation. The distribution of schwa in clitics is predictable from the phonological and morphological context, which makes its presence underlyingly unnecessary. We may assume that the presence of schwa in the citation form follows from a requirement in French that all prosodic words or utterances contain a vowel. Déchaine (1990, 1991) also comes to the conclusion that clitics do not contain underlying schwas in Québec French.

[7]Contra Martinet (1969, 1972). Dell (1973/1980/1985), Morin (1974), Verluyten (1988), Noske (1993) also argue against Martinet for reasons of predictability. However, the unpredictability of schwa in the initial syllable of polysyllabic morphemes cannot be extended to schwa in general, as done e.g. by Verluyten (1988) and Noske (1993, 1996). Note that these morpheme-internal schwas often tend to either disappear or become stable in various dialects, with a substantial amount of idiolectal variation. See Walter (1977, 1990), Hansen (1994), and Walker (1996) about the stabilization of schwa in Parisian French.

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pursue it. So the additional vowel in (1a), which appears at a clitic-noun boundary, is not present underlyingly; the process here is one of vowel insertion, not schwa deletion, as is assumed in most studies. I take every morphological juncture to be a potential site for epenthesis. However, I exclude from consideration junctures followed by a 'h aspiré', however these should be treated (see e.g. Dell 1973/1980/1985 and Tranel 1981 for different views on this topic).

**2.1.2. THE DISTRIBUTION OF SCHWA ACROSS CONTEXTS**

Before reviewing and assessing the syllabic proposals, it is necessary to get a sufficiently clear picture of the facts. The behavior of schwa depends on the segmental, prosodic, and morphological context. The following morphological contexts may be identified, with one example for each of them. I use "+" to indicate any word-internal boundary, "=" for clitic boundaries and a space for (phonological) word boundaries.

(2)     CONTEXTS OF OCCURRENCE OF SCHWA:
        Junctures:[8]
        a. Before the (consonant-initial) derivational suffixes *-ment, -rie, -té*[9]:
           *justement*          'justly'          /ʒyst+mã/          [ʒyst<u>ə</u>mã]
           *garderie*          'daycare'          /gard+ri/          [gard<u>ə</u>ri]
           *propreté*          'cleanliness'          /prɔpr+te/          [prɔpr<u>ə</u>te]
        b. Before conditional and future endings, except 1st/2nd plural conditional:
           *doublerai*          'double+FUT.1SG'          /dubl+re/          [dubl<u>ə</u>re]
        c. Before the 1st/2nd plural conditional endings *-rions/-riez*:
           *fumeriez*          'smoke+COND.2PL'          /fym+rje/          [fym<u>ə</u>rje]
        d. At clitic boundaries (all clitics are proclitics: *te, que, de, se, ce, je, me, ne, le*):
           *Alice le fait*          'A. does it'          /alis l=fɛ/          [alisl<u>ə</u>fɛ]
           *bol de lait*          'bowl of milk'          /bɔl d=lɛ/          [bɔld<u>ə</u>lɛ]
           *il pense que non*          'he thinks not'          /il=pɑ̃s k=nɔ̃/          [ilpɑ̃sk<u>ə</u>nɔ̃]

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[8]There is an additional junctural context where schwa may appear: between elements of compounds, as in (i):

(i)     *garde-robe*          'wardrobe'          /gard+rɔb/          [gard<u>ə</u>rɔb]

I leave compounds aside, which seem to behave mostly like sequences of words from the segmental point of view, with less variation. An important distinction between compounds and words concerns the effect of rhythm, more specifically the number of syllables in the second member of the compound. The relevant facts are described in Léon (1966) and analyzed in Mazzola (1992) and Côté (2000a).

[9]See Morin (1978) for additional suffixes, which are very restricted and not productive.

e.  At word boundaries (including verb-pronoun boundaries):
    *acte pénible*        'painful act'        /akt penibl/        [akt(ə)penibl]
    *ferme-toi*           'close yourself'     /fɛrm twa/          [fɛrm(ə)twa]

<u>Morpheme-internal</u>:
f.  In the first syllable of polysyllables:
    *une demande*         'a request'          /yn dəmãd/          [ynd̪əmãd]

It is an absolute rule that schwa never appears next to a vowel. In this respect schwa contrasts with all other vowels in French, which freely appear in hiatus. Underlying schwas are all in interconsonantal position[10], and epenthesis never takes place at a boundary that is adjacent to a vowel. The following examples illustrate the failure to epenthesize next to a vowel.

(3)    NO SCHWA NEXT TO A VOWEL:
       a.  *beauté*          'beauty'             /bo+te/          [bote] *[boəte]
       b.  *louerai*         'rent+FUT.1SG'       /lu+re/          [lure] *[luəre]
       c.  *geste adroit*    'agile gesture'      /ʒɛst adrwa/     [ʒɛstadrwa] *[ʒɛst̪əadrwa]

Utterance-initial (post-pausal) and utterance-final (pre-pausal) schwas[11] are also not found in the speech described here (4). Note that utterance-initial schwas occur in other varieties, e.g. the colloquial French of lower-middle-class Parisians (according to Morin's (1987a) subjective description) and in Québec French. The analysis proposed here naturally accounts for the absence of epenthesis at utterance edges in the dialect under consideration, but also allows for the existing variation on this point.

(4)    NO SCHWA UTTERANCE-INITIALLY AND UTTERANCE-FINALLY:
       a.  *je parlais*      'I spoke'            /ʒ=parlɛ/        [ʒ(ə)parlɛ] *[əʒparlɛ]
       b.  *la piste*        'the track'          /la=pist/        [lapist] *[lapist̪ə]

From the facts illustrated in (3) and (4), it follows that schwa occurs only between two consonants. It has long been noticed that the distribution of schwa depends largely on what precedes the boundary or the underlying schwa. But the following context also has an effect. In reviewing the relevant data about schwa, I find it useful to distinguish the segmental contexts according to the number of preceding and following consonants: 1. C*C: the boundary or underlying schwa is preceded and followed by only one consonant; 2. C*CC: the boundary or underlying schwa is preceded by only one consonant and followed by two; 3. CC*C: the boundary or underlying schwa is followed by only one consonant and preceded by two. The asterisk * here and in the rest of this chapter indicates any potential site where schwa may surface, either a boundary or an underlying schwa. In the table below, I indicate for each combination of the morphological and segmental contexts whether schwa is obligatory, optional, or excluded. In several categories, the behavior of schwa is not uniform and depends on the nature of the consonants. That is, in a given morphological context and with a given number of consonants, schwa may be optional or excluded, or optional or obligatory. When the case arises I provide an example for each possibility, without stating the more specific conditions that determine the choice. These conditions are far from clear and have not been seriously investigated. The main goal of this chapter is precisely to define them.

Note that the distinction between optional and excluded schwa after one consonant is a subtle one and should not be interpreted too radically. One could argue that schwa is always possible, under the right conditions. But some schwas (in clitics and morpheme-internally) sound normal in natural linguistic conditions, whereas others (at word boundaries and word-internally before suffixes) require special circumstances. In these cases I considered schwa to be excluded, but the analysis would not be radically altered by considering it simply more marked or less likely.[12]

The complexity of the distribution of schwa and the fact that most studies of it focus on a subset of the data make it useful to have a complete picture presented in a condensed form. This will also allow us to get a clearer idea of the empirical adequacy of the analyses I present and discuss below.

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[10]Cases like *dehors* 'outside' [dœɔr] are irrelevant: I consider the first vowel to be a stable [œ] and not a schwa, since it is always pronounced.

[11]Schwas may be found utterance-finally in 'educated Parisian French' (Fagyal 1998, 2000), but they derive from an epenthesis process that is to be distinguished from the one analyzed here. These schwas are rhythmically-conditioned and serve to avoid final stress and create an (unmarked) trochaic foot. They may appear in practically any segmental context, including sometimes after vowels (a fact overlooked by Fagyal). This is very similar to the situation found in Galician (Martínez-Gil 1997).

[12]Strong emphasis expressed by initial stress may for instance license schwa in forms like *doucement* 'gently, slowly' [**dú**səmã] or *donne-lui!* [**dɔ́**nəlɥi] 'give him!', in which schwa may serve to avoid a clash between the (emphatic) initial stress and the (regular) final one. But I have considered schwa in these contexts to be generally excluded. Schwa also seems to appear quite freely in the sequence [ɲ-m], e.g. in *enseignement* 'teaching' [ãsɛɲ(ə)mã] and *dignement* 'with dignity' [diɲ(ə)mã]. I leave this sequence aside here.

Table 3:
**Distribution of schwa across various morphological and segmental contexts**

| /C*C/ | /C*CC/ | /CC*C/ |
|---|---|---|
| **a. Before derivational suffixes** | | |
| (5) ə EXCLUDED<br>*fruiterie* /frɥit+ri/<br>'fruit store' [frɥitri] | N/A | (15) ə OBLIGATORY<br>*garderie* /gard+ri/<br>'kindergarden' [gardəri] |
| **b. Before future/conditional endings (except cond. 1/2 plural)** | | |
| (6) ə EXCLUDED<br>*gâterai* /gat+re/<br>'spoil+FUT.1SG' [gatre] | N/A | (16) ə OBLIGATORY<br>*doublerai* /doubl+re/<br>'double+FUT.1SG' [dubləre]<br><br>(17) ə OPTIONAL<br>*garderai* /gard+re/<br>'keep+FUT.1SG' [gard(ə)re] |
| **c. Before conditional 1st/2nd plural endings** | | |
| N/A | (10) ə OBLIGATORY<br>*gâteriez* /gat+rje/<br>'spoil+COND.2PL' [gatərje] | (18) ə OBLIGATORY<br>*garderiez* /gard+rje/<br>'keep+COND.2PL' [gardərje] |
| **d. At clitic boundaries** | | |
| (7) ə OPTIONAL<br>*Annie le salut* /ani l=saly/<br>'A. greets him' [anil(ə)saly]<br><br>*plein de linguistes*<br>'full of linguists'<br>/plɛ̃ d=lɛ̃gɥist/<br>[plɛ̃d(ə)lɛ̃gɥist] | (11) ə OPTIONAL<br>*Annie le grondait* /ani l=grɔ̃dɛ/<br>'A. scorned him' [anil(ə)grɔ̃dɛ]<br><br>*plein de psychologues*<br>'full of psychologists'<br>/plɛ̃ d=psikɔlɔg/<br>[plɛ̃d(ə)psikɔlɔg] | (19) ə OBLIGATORY<br>*Annick le salut* /anik l=saly/<br>'A. greets him' [anikləsaly]<br><br>(20) ə OPTIONAL<br>*Esther le salut* /ɛstɛr l=saly/<br>'E. greets him' [ɛstɛrl(ə)saly] |
| **e. At word boundaries** | | |
| (8) ə EXCLUDED<br>*attaque pénible* /atak penibl/<br>'painful attack' [atakpenibl] | (12) ə EXCLUDED<br>*attaque frontale* /atak frɔ̃tal/<br>'frontal attack' [atakfrɔ̃tal]<br><br>(13) ə OPTIONAL<br>*(il n')aime rien* /ɛm rjɛ̃/<br>'(he) likes nothing' [ɛm(ə)rjɛ̃] | (21) ə OPTIONAL<br>*acte pénible* /akt penibl/<br>'painful act' [akt(ə)penibl] |
| **f. Morpheme-internally** | | |
| (9) ə OPTIONAL<br>*la fenêtre* /la=fənɛtr/<br>'the window' [laf(ə)nɛtr] | (14) ə OPTIONAL<br>*la secrétaire* /la=səkretɛr/<br>'the secretary' [las(ə)kretɛr] | (22) ə OBLIGATORY<br>*une demande* /yn dəmãd/<br>'a request' [yndəmãd]<br><br>(23) ə OPTIONAL<br>*une fenêtre* /yn fənɛtr/<br>'a window' [ynf(ə)nɛtr] |

As repeatedly mentioned in research on schwa, the tendency is for schwa to be absent when only one consonant precedes, irrespective of the number of following consonants (first two columns), and to be present after more than one consonant (last column). As a consequence, the context following potential sites for schwa (any juncture or underlying schwa) has been largely neglected. But the facts are more subtle and complex, and I believe that the distinction made between C*CC and C*C contexts is warranted and necessary. Let us quickly go over the relevant facts.

C*CC qualitatively differs from C*C in two cases. First, the 1st/2nd person plural conditional endings -*rions*/-*riez* (UR: /-rjɔ̃, -rje/) trigger obligatory schwa insertion after *all* consonant-final verbal stems, whether preceded by one or two consonants (10, 18).[13] In the context C*C schwa is never required. Second, whereas at word boundaries I consider schwa to be generally excluded in the context C*C, epenthesis appears to be optional with certain sequences in the context C*CC. Words beginning in a /r/+glide sequence (/rj-, rw-, rɥ-/) are among those that optionally trigger schwa insertion after a consonant-final word (13); compare them with the 1st/2nd plural conditional endings -*rions*/-*riez*. But other combinations also have this effect. In addition to word boundaries and 1st/2nd plural conditional endings, we find a quantitative difference in the likelihood of schwa between C*C and C*CC contexts at clitic boundaries and morpheme-internally: schwa is more likely to appear in C*CC (11, 14) than in C*C (7, 9).

In the preceding table, a vowel always intervenes between the relevant epenthesis site and the beginning of the utterance (context /…VC(C)*C(C)V…/). For the contexts d. (at clitic boundaries) and f. (morpheme-internally), however, the consonant that precedes the underlying schwa or the boundary may appear post-pausally (context /C*C(C)V…/):

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[13]The sequences /C+rjɔ̃/ and /C+rje/ can also surface without schwa but with vocalization of the glide: [Crijɔ̃] / [Crije]. The important point is that the sequence [Crj] is banned. I only consider the schwa strategy here. Note that in normative French, the two repair strategies are mutually exclusive: schwa appears with verbs of the first conjugation (verbs in -*er*), while glide vocalization is used with verbs of the third group. The verbs *fonder* 'to found' and *fondre* 'to melt' form in this respect a minimal pair: their second plural conditional forms are, respectively, *fonderiez* [fɔ̃dərje] and *fondriez* [fɔ̃drije]. This distinction has led to the postulation of an underlying thematic schwa after stems of the first group (e.g. Dell 1973/1980/1985). But this contrast has largely disappeared in the spoken language, both strategies being available for all verbs (with very few exceptions), e.g. *aimeriez* 'like+COND.2PL' [ɛmərje] / [ɛmrije] (first group) and *prendriez* 'take+COND.2PL' [prãdrije] / [prãdərje]. See Martinet (1969), Morin (1978), Bazylko (1981), Spence (1982). Bazylko in particular designed tests that show that speakers do not distinguish between [fɔ̃dərje] and [fɔ̃drije], both forms being available for the conditional of both *fonder* and *fondre*.

(24)    OPTIONAL SCHWA AFTER A POST-PAUSAL CONSONANT:
    a.  *le salut*          'the greeting'      /l=saly/         [l(ə)saly]
    b.  *te fais pas de bile* 'don't worry'     /t=fɛ pa d=bil/  [t(ə)fɛpadbil]
    c.  *demande-la*        'request it'        /dəmɑ̃d la/        [d(ə)mɑ̃dla]
    d.  *je suis*           'I am'              /ʒ=sɥi/          [ʒəsɥi] [ʃsɥi]

In this case, schwa is generally optional, irrespective of the nature of the consonants.[14] The two examples in (24a,c) thus contrast with their utterance-medial counterpart given in (19) and (22), in which schwa is obligatory. The tolerance for practically any two-consonant cluster phrase-initially is well-known and discussed in numerous sources, from Grammont (1914/1961) and Fouché (1959) to Dell (1973/1980/1985), Rialland (1986), Tranel (1987a), and Noske (1993). Notice that these phrase-initial sequences may violate the Sonority Sequencing Principle, for example the sequence [ls] in (24a).

## 2.2. SYLLABIC ACCOUNTS

With these data in hand, we can review and evaluate the various approaches that have been taken in accounting for the distribution of schwa, in particular the syllabic ones. References to syllable well-formedness are numerous, dating back to at least Lesaint (1871), who writes: "Dans le corps du mot, l'e est muet toutes les fois que la consonne dont il est précédé peut, dans la prononciation, se joindre sans difficulté, sans effort, à la syllabe qui précède ou à celle qui suit." (Lesaint 1871: 33). In more recent times, explicitly syllabic analyses include: Pulgram (1961), Morin (1974), Cornulier (1975), Bouchard (1981), Anderson (1982), Noske (1982, 1988, 1993, 1996), Montreuil (1985), Tranel (1987a, 1999, 2000), Spa (1988), and Carbonneau (1989).[15]

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[14] Two segmental restrictions have been mentioned in the literature. First, Dell (1973/1980/1985) claims that schwa must be present if the initial consonants are both stops, as in *te casse pas la tête!* 'don't overdo it!' /t=kas pa la=tɛt/ [tə̠kaspalatɛt]. Morin (1974) disagrees and gives a schwaless pronunciation for *te tracasse pas* 'don't worry' /t=trakas pa/ [ttrakaspa]. I believe there is a tendency to insert a schwa in such contexts, but this is not an absolute requirement. (See also Grammont 1914/1961: 117-118). Second, Fouché (1959) suggests that schwa is obligatory if the two consonants are identical. But Rialland (1994) gives the pronunciation [sswar] for *ce soir* 'this evening' (UR: /s=swar/), Léon (1966) gives [ʒʒu] for *je joue* 'I play (UR: /ʒ=ʒu/), and Malécot (1976) [ssɔ̃] for *ce sont* 'these are' (UR: /s=sɔ̃/); Morin's example above makes the same point, with a stop rather than a fricative in initial position. Here again, there may be a tendency rather than a law.

[15] To this list could be added two related foot-based analyses – Selkirk (1978) and Withgott (1982) – as well as Charette (1991), whose proposal is cast in Government Phonology. In this framework, the syllable is not recognized as a constituent, but its dependents, the onset and the rime, are. See Lyche & Durand (1996) for a detailed critique of Charette's analysis. Basbøll (1978, 1988) also discusses the role of the syllable in the behavior of ə, with respect to the ə/ɛ alternation (note 4).

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These contrast with the purely sequential analyses found in e.g. Grammont (1894, 1914/1961), Fouché (1959), Dell (1973/1980/1985), Domingue (1974), Malmberg (1976), Lyche (1978, 1979), and Spence (1982).[16] None of these studies – even Dell's, which still offers after 25 years the most complete analysis and description to date – entirely captures the complexity of the data. But my point here is to show that substantial progress *cannot* be made within a syllable-based approach.

### 2.2.1. PULGRAM (1961)

All the syllabic proposals are based on the principle of exhaustive syllabification of the string of segments. Schwa is required whenever the surrounding consonants cannot be properly syllabified without it; it provides an additional nucleus to which the consonants can attach. But authors differ on the definition of a possible syllable in French. For Pulgram (1961)[17], all consonant sequences that are attested pre-pausally (word-finally) and post-pausally (word-initially) form acceptable codas and onsets, respectively (although Pulgram did not specifically use these terms). Therefore, domain-internally, a schwa must appear where its omission would produce a consonant cluster that cannot be decomposed into a permissible word-final (pre-pausal) sequence followed by a permissible word-initial (postpausal) sequence. Otherwise, schwa is considered optional, depending on style and other factors.

The empirical weaknesses of this early syllabic treatment were soon noticed; see Dauses (1973) and Morin (1982). The most obvious shortcoming is that it widely overgenerates, as it predicts schwa omission in consonantal contexts in which it is impossible. Pulgram's proposal is expected to account for all the cases of obligatory schwa in the table above, but its performance in this respect is quite weak. All cases of obligatory schwa at word-internal junctures (first three morphological contexts in table 3) are actually predicted to be grammatical without schwa by Pulgram's rule. Yet a schwa always appears: 1. before a consonant-initial derivational suffix when the stem ends in two or more consonants (25); 2. before future and conditional endings (other than 1st/2nd plural conditional) with verbal stems ending in obstruent+sonorant sequences (26); 2. before 1st/2nd plural conditional endings with all consonant-final verbal stems (27).

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[16] Verluyten (1982, 1985a, 1985b) also develops a rhythmic account of the behavior of schwa, which I will not discuss here.

[17] Weinrich's (1961) proposal was essentially identical, although not explicitly expressed in syllabic terms. Weinrich (1961) is a modified version of Weinrich (1958), produced in response to Baldinger's (1958) criticism.

(25)   OBLIGATORY SCHWA BEFORE DERIVATIONAL SUFFIXES:
       a. *justement* 'justly'          [ʒystəmã] *[ʒystmã]   (UR: /ʒyst+mã/)
       b. *garderie* 'kindergarden'     [gardəri] *[gardri]   (UR: /gard+ri/)
       c. *propreté* 'cleanliness'      [prɔprəte] *[prɔprte] (UR: /prɔpr+te/)

(26)   OBLIGATORY SCHWA BEFORE FUTURE AND CONDITIONAL ENDINGS:
       a. *doublerai* 'double+FUT.1SG'  [dubləre] *[dublre]   (UR: /dubl+re/)
       b. *entrerai* 'enter+FUT.1SG'    [ãtrəre] *[ãtr(r)e]   (UR: /ãtr+re/)

(27)   OBLIGATORY SCHWA BEFORE 1ST/2ND PLURAL CONDITIONAL ENDINGS:
       a. *gâterions* 'spoil+COND.1PL'  [gatərjõ] *[gatrjõ]   (UR: /gat+rjõ/)
       b. *fumeriez* 'smoke+COND.2PL'   [fymərje] *[fymrje]   (UR: /fym+rje/)
       c. *garderiez* 'keep+COND.2PL'   [gardərje] *[gardrje] (UR: /gard+rje/)

In all these examples, the schwaless outputs are predicted to be acceptable by Pulgram's law since they contain a permissible word-final sequence followed by a possible word-initial one.[18] For example, the group [stm] in (25) can be decomposed into the word-final cluster [-st] (e.g. *liste* 'list' [list]) followed by word-initial [m-]. In some cases the sequence can even be decomposed in two ways. In (25b), [rdr] can be decomposed as [-rd]+[r-] or [-r ]+[dr-] ([-rd] as in *garde* [gard]; [dr-] as in *dru* [dry]). The basic problem for Pulgram is that in all the forms in (25)-(27), the stem itself corresponds to a possible word. These stem-final clusters are therefore always permissible word-final sequences. The suffix-initial consonant(s) are also always acceptable word-initially. Therefore these consonant clusters can always be decomposed according to Pulgram's rule, the syllable boundary corresponding to the morphological one.

There are two other contexts for obligatory schwa: at clitic boundaries and morpheme-internally. Here Pulgram's law accounts only for a subset of the obligatory cases. Take the following examples of mandatory schwa in clitic groups:

(28)   OBLIGATORY SCHWA IN CLITIC GROUPS:
       a. *Philippe me salut* 'P. greets me'   [filipməsaly]   (UR: /filip m=saly/)
       b. *Philippe le salut* 'P. greets him'  [filipləsaly]   (UR: /filip l=saly/)

The absence of schwa would yield the sequences [pms] and [pls]. Schwa insertion is predicted by Pulgram in the first case, since [pms] is not decomposable into a word-final sequence followed by a word-initial one: [-pm] and [-ms] are not attested word-

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[18]Note that many of the ungrammatical forms below are acceptable in other varieties, e.g. Saint-Etienne French (Morin 1983).

finally and word-initially, respectively. But Pulgram's law does not lead us to expect schwa epenthesis in (28b), since [pls] is decomposable into [-pl] + [s-].

Overgeneration is the most obvious weakness of Pulgram's approach. But it also undergenerates, in that it predicts schwa to be obligatory in contexts where it is only optional. It does so phrase-initially, as in the examples in (24), repeated below:

(24)   OPTIONAL SCHWA AFTER PHRASE-INITIAL CONSONANTS:
       a. *le salut*          'the greeting'   /l=saly/       [l(ə)saly]
       b. *te fais pas de bile* 'don't worry'  /t=fɛ pa d=bil/ [t(ə)fɛpadbil]
       c. *demande-la*        'request it'     /dəmãd la/      [d(ə)mãdla]
       d. *je suis*           'I am'           /ʒ=sɥi/         [ʒəsɥi] [ʃsɥi]

Domain-initially, schwa is expected to occur if its omission would produce a cluster that is not a permissible onset. The omission of schwa in these examples yields the sequences [ls], [tf], [dm] and [ʃsɥ], which are not found word-initially in the lexicon. So they should not constitute acceptable onsets and the forms in (24) should be ungrammatical without schwa. Pulgram actually discusses comparable examples, and concludes that these clusters ought to be listed among the permissible onsets, to the extent that they are attested post-pausally. This account seems to fall into circularity: schwa omission is considered possible because it yields clusters that are possible onsets, but the permissibility of these onsets is itself determined only on the basis of schwa omission in these forms. This cannot be an explanation.

**2.2.2. SUBSEQUENT ANALYSES**

Subsequent syllabic analyses tried to develop a more restrictive theory, which would eliminate the important overgeneration problem encountered by Pulgram's approach (Morin 1974; Bouchard 1981; Anderson 1982; Noske 1988[19], 1993, 1996; Tranel 1987a). This was done by restricting the notion of possible syllables in French and limiting the resyllabification possibilities across boundaries or deleted underlying schwas. These analyses differ in various aspects, but a unified presentation is possible. I start with the most restrictive approach, one that contains all the necessary ingredients to predict schwa insertion/retention in all the contexts

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[19]I will not consider Noske (1982), but only its revised French version (1988). Noske (1982) allows schwa to be absent before derivational suffixes preceded by two consonants (e.g. *burlesquement* [byrlɛskmã]). These pronunciations are very generally rejected by speakers of the relevant variety and are based on some scattered and inconsistent pronunciations found in pronunciation dictionaries, in particular Juilland (1965). These forms were correctly removed from the later French version of this article (1988), and the analysis revised accordingly. See Morin (1987a) for insightful comments on these and other problematic data.

where it is indeed obligatory. As this system turns out to be too restrictive in other contexts, we will see how it can be relaxed or amended to improve its empirical adequacy. I conclude, however, that the modifications that have to be integrated into the system are such that they in essence deprive the syllable of its usefulness and motivation. There is then no argument for adopting an analysis based on syllable well-formedness conditions over one that only refers to sequences of elements – segments and boundaries.

### 2.2.2.1. Step 1: the most restrictive approach

The correct theory of schwa must be able to derive all the cases of obligatory schwa insertion/retention (see table 3). In order to do so, it has been proposed that it should include the two assumptions in (29).

(29)    TWO ASSUMPTIONS THAT ACCOUNT FOR CASES OF OBLIGATORY SCHWA:
     a. French allows only one coda consonant. Complex onsets are tolerated (Bouchard 1981; Anderson 1982; Noske 1988, 1993, 1996).
     b. Consonants cannot resyllabify across a boundary or deleted schwa (Morin 1974; Bouchard 1981; Anderson 1982; Tranel 1987a).

The conditions on syllable well-formedness in (29a), in particular the fact that complex codas are prohibited, entail that any sequence of three consonants $C_1C_2C_3$ can only be syllabified $C_1.C_2C_3$, provided $C_2C_3$ is a permissible onset. What constitutes a permissible onset is not entirely clear, but in any case, stop+liquid (except /tl, dl/) and /f/+liquid clusters have to be included into the set of acceptable onsets, with the possible addition of /s/ before the cluster.

Condition (29b) disallows resyllabification of consonants across a boundary or deleted schwa.[20] It is implemented in different ways by Morin, Bouchard, Anderson, or Tranel, but the effect is essentially the same, that of preventing resyllabification. From (29b) it follows that in an underlying sequence /$VC_1$-$C_2V$/ where "-" indicates any boundary, $C_1$ cannot associate with $C_2$ to form a complex onset and has to be syllabified as a coda with the preceding vowel. The same holds for an input /$VC_1$ə$C_2V$/ if /ə/ deletes. When the boundary or the underlying schwa is preceded by two consonants, the conjunction of (29a) and (29b) makes the sequence unsyllabifiable. Consider an input /$VC_1C_2$*$C_3V$/ (/$C_1C_2$-$C_3V$/ or /$VC_1C_2$ə$C_3V$/). Both outputs *[$VC_1C_2.C_3V$] and *[$VC_1.C_2C_3V$] are excluded, the first one by the ban

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[20] This condition actually only applies when the boundary is followed by a consonant. Consonants do resyllabify to the right across a boundary when followed by a vowel, e.g. *une idée* 'an idea' /yn ide/ would surface as [y.ni.de].

on complex codas (29a), the second one by the no-resyllabification constraint (29b). If we assume in addition that consonantal syllabic nuclei are prohibited in French, there is no available syllabification for $C_2$ in sequences of the type /$VC_1C_2$*$C_3V$/ without schwa in the designated site, which is obligatory to provide $C_2$ with a nucleus to attach to.

Let us see more specifically the effect of the assumptions in (29) on the behavior of schwa. I list below all the contexts in which schwa is obligatory. There are five of them; the last three are just repetitions of data in (25)-(27) discussed in the context of Pulgram's proposal.

(30)    OBLIGATORY SCHWA MORPHEME-INTERNALLY:
     a. *une demande*    'a request'    /yn dəmãd/    [yndəmãd]
     b. *sept melons*    'seven melons'    /sɛt məlɔ̃/    [sɛtməlɔ̃]

(31)    OBLIGATORY SCHWA AT CLITIC BOUNDARIES:
     a. *Annick le salut*    'A. greets him'    /anik l=saly/    [anikləsaly]
     b. *Philippe te conduit*    'P. drives you'    /filip t=kɔ̃dɥi/    [filiptəkɔ̃dɥi]

(25')    OBLIGATORY SCHWA BEFORE DERIVATIONAL SUFFIXES:
     a. *justement*    'justly'    /ʒyst+mã/    [ʒystəmã]
     b. *garderie*    'kindergarden'    /gard+ri/    [gardəri]
     c. *propreté*    'cleanliness'    /prɔpr+te/    [prɔprəte]

(26')    OBLIGATORY SCHWA BEFORE FUTURE AND CONDITIONAL ENDINGS:
     a. *doublerai*    'double+FUT.1SG'    /dubl+re/    [dubləre]
     b. *entrerai*    'enter+FUT.1SG'    /ãtr+re/    [ãtrəre]

(27')    OBLIGATORY SCHWA BEFORE 1ST/2ND PLURAL CONDITIONAL ENDINGS:
     a. *gâterions*    'spoil+COND.1PL'    /gat+rjɔ̃/    [gatərjɔ̃]
     b. *fumeriez*    'smoke+COND.2PL'    /fym+rje/    [fymərje]
     c. *garderiez*    'keep+COND.2PL'    /gard+rje/    [gardərje]

The assumptions in (29) correctly and straightforwardly predict the obligatory presence of schwa in the output in the first four cases. Their input is of the form /$VC_1C_2$-$C_3V$/ (31, 25', 26') or /$VC_1C_2$ə$C_3V$/ (30), which, as shown above, are unsyllabifiable without schwa. I illustrate in (32) with the examples in (30a) and (25'b) how exhaustive syllabification cannot be achieved without the insertion or retention of schwa. I obviously assume that repair strategies other than vowel insertion, in particular consonant deletion, are unavailable for independent reasons.

(32)    HOW (29) PREDICTS SCHWA INSERTION / RETENTION:

| Input | Possible outputs | Comment |
|---|---|---|
| a.  /yn dəmɑ̃d/ | *[yn.dmɑ̃d] | Excluded by (29b): |
| | | [d] cannot resyllabify across a deleted /ə/ |
| | *[ynd.mɑ̃d] | Excluded by (29a): |
| | | [nd] is not allowed as a complex coda |
| | *[yn.d.mɑ̃d] | Consonantal nuclei are not allowed |
| | [yn.də.mɑ̃d] | OK |
| b.  /gard+ri/ | *[gar.dri] | Excluded by (29b): |
| | | [d] cannot resyllabify across a boundary |
| | *[gard.ri] | Excluded by (29a): |
| | | [rd] is not allowed as a complex coda |
| | *[gar.d.ri] | Consonantal nuclei are not allowed |
| | [gar.də.ri] | OK |

Notice that the first output in (32a) – *[yn.dmɑ̃d] – could be excluded without the assumption concerning resyllabification (29b). The sequence [dm], it can be argued, does not form a possible onset. So even if the [d] were allowed to resyllabify with the following [m], we would not obtain an acceptable output. The same cannot be said, however, of the first output in (32b): *[gar.dri], with resyllabification of the [d], is a perfectly acceptable form, like *perdrix* 'partridge' [pɛr.dri]. Yet schwa cannot be omitted here. It is for cases like these that the assumption (29b) is crucially needed.[21]

We still have to discuss the case of the 1st/2nd plural conditional endings (27'). The relevant underlying sequences here are of the form /(C)C+rjV/. With stems ending in a two consonant-cluster, like *gard-* in (27'c), schwa insertion is derived in the same way as in (32) above. But what about stems ending in only one consonant, like *gât-* and *fum-* in (27'a-b)? Here it is not clear that schwa insertion is predicted by the assumptions in (29). The input is of the form /VC+rjV/. The stem-final consonant is automatically licensed in coda position. The fate of the output [VC.rjV] then rests entirely on the status of [rj] as a possible onset. If [rj] is assumed to be an acceptable onset, nothing so far rules out forms like *[fym.rje] (27'b) and *[gat.rjɔ̃] (27'a) and schwa insertion is not predicted. To derive obligatory schwa insertion in these cases, let us assume that [rj] is *not* a possible onset. This is not an implausible

assumption. It is supported by the fact that this sequence occurs word-initially – for instance in *rien* 'nothing' [rjɛ̃] – but not word-internally after a consonant *[VCrjV].[22] The initial /r/ in /rjɛ̃/ would then be considered extrasyllabic (see following section), and in a word like *parier* 'to bet' [par.je], the syllable boundary would be put between the two consonants. Extrasyllabic consonants being allowed only at domain edges, an output like *[fymrje] (27'b) cannot be properly syllabified. The schwa inserted at the morphological boundary then provides a coda for the /r/ to go into [fy.mər.je].[23]

We have now derived by means of the two assumptions in (29) all the cases of obligatory schwa in table 3. This represents a substantial improvement over Pulgram's analysis, which predicted schwa to be optional in all these examples. A theory based on (29) and the requirement of exhaustive syllabification, however, is too restrictive, as it also predicts schwa to be obligatory in contexts where it is not. Schwa is expected to occur in *any* sequence of the form /CC*C/, that is all the contexts in the rightmost column in table 3. Yet there are four contexts in which schwa may be omitted in certain forms: before future/conditional endings (other than 1st/2nd plural conditional), at clitic boundaries, at word boundaries, and morpheme-internally. We also saw in (24) that schwa insertion is not required phrase-initially, even when the resulting initial sequence of consonants can hardly be considered an acceptable onset, like [ls] (24a) or [ʃsɥ] (24d). Exhaustive syllabification then predicts obligatory schwa insertion, contrary to facts. For these cases the assumptions in (29) offer no solution and do not fare better than Pulgram's (1961) proposal. Let us now see how the theory can be relaxed to accomodate these cases.

### 2.2.2.2. Step 2: allowing for extrasyllabicity

Allowing for extrasyllabic consonants at edges of prosodic constituents provides the obvious solution to many of the cases where schwa is incorrectly required to be obligatory. As can be seen in table 3 and in the examples below,

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[21]Noske (1988) actually takes [gardri] for *garderie* to be grammatical, and more generally all outputs [-C.Or-] for underlying /CO+r/ (where O=obstruent). This opinion is clearly not shared by other researchers, e.g. Dell, Morin, Tranel, to name just a few, including myself. The obligatory presence of schwa between two consonants and consonant-initial derivational suffixes is a well-established fact and I will disregard Noske's claim.

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[22]Except with a geminate /r/, as in *verriez* 'see+COND.2PL', pronounced [vɛrrje] (or [vɛrje]).

[23]Noske (1982, 1988) suggests that /rj/ *is* a possible onset, but that /Crj/ is not. To rule out forms like *[gatrjɔ̃] for *gâterions* (27'a), he proposes that obstruent-liquid sequences are always tautosyllabic. As a result the syllabification [ga.trjɔ̃] is excluded because [trj] is not a possible onset, and [gat.rjɔ̃] is out because the sequence [tr] cannot be broken by a syllable boundary. Hence the presence of schwa [gatərjɔ̃]. The tautosyllabicity requirement for obstruent-liquid clusters can be questioned, however. According to my intuition, a form like *hanterait* 'haunt+COND.3SG' [ɑ̃t.rɛ] (UR: /ɑ̃t+rɛ/) has the indicated syllabification and contrasts with *entrait* 'enter+IMPERFECT.3SG' [ɑ̃.trɛ] (UR: /ɑ̃tr+ɛ/). With stems ending in a non-obstruent consonant like *fumeriez* (27'b), Noske offers a slightly different solution to rule out *[fym.rje], which does not involve a tautosyllabicity requirement between the /r/ and the preceding consonant. I leave it aside. But note that a uniform solution for all 1st/2nd plural conditional forms would certainly be preferable.

schwa is never obligatory at word boundaries, although in some contexts, as in (33c), the pronunciation with schwa can be considered highly preferable (see section 2.3.2 regarding such examples).

(33)   OPTIONAL SCHWA AT WORD BOUNDARIES:
    a. *acte pénible*    'painful act'    /akt penibl/    [akt(ə)penibl]
    b. *bourse pleine*    'full purse'    /burs plɛn/    [burs(ə)plɛn]
    c. *rythme sauvage*    'wild rhythm'    /ritm sɔvaʒ/    [ritm(ə)sɔvaʒ]

These examples straightforwardly follow if we assume that consonants not admitted in the coda are licensed by extrasyllabicity word-finally. I presented in section 1.2.1.1. various approaches to extrasyllabicity and the way extrasyllabic consonants are ultimately licensed. For the sake of explicitness I assume that extrasyllabic consonants word-finally attach directly to the prosodic word. The schwaless output in (33b) would then have the representation in (34):

(34)   EXTRASYLLABICITY OF WORD-FINAL CONSONANTS:
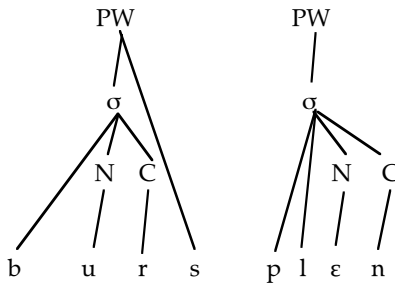


The optionality of schwa in most future and non-1st/2nd plural conditional forms (35) could be accounted for by assimilating the boundary to a word level one. These verbal endings may be analyzed as some kind of word-level affix, contrasting with derivational suffixes (cf. the mandatory schwa in *garderie* [gardəri]). The stem-final consonant would then be allowed to be extrasyllabic, as in (34) above.[24]

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[24]Table 3 contains future/conditional forms in which I consider schwa to be obligatory, e.g. *doublerai* 'double+FUT.1SG' [dubləre] *[dublre]. Given the proposed correspondence between the future/conditional and word boundaries, one may wonder why schwa is not always optional in the future/conditional as I have assumed it is at word boundaries. This assumption should actually be qualified somewhat. In very close syntactic contexts, like adjective+noun groups, schwa can be considered almost obligatory with certain consonant sequences, precisely those that obligatorily trigger schwa insertion in the future/conditional. These are sequences that violate the SSP, as we will see in section 2.3.2. So there may not be a real contrast between word and future/conditional boundaries.

(35)   OPTIONAL SCHWA BEFORE FUTURE AND CONDITIONAL ENDINGS:
    a. *garderai*    'keep+FUT.1SG'    /gard+re/    [gard(ə)re]
    b. *postera*    'mail+FUT.3SG'    /pɔst+ra/    [pɔst(ə)ra]

The same mechanism of extrasyllabicity can be used domain-initially to account for word-initial /rj/ sequences (36a), as we assumed above that this sequence was not a possible onset, and the generally freer distribution of consonants phrase-initially (24). This account of /rj/ extends to other /r/+glide sequences /rɥ, rw/, as in (36b).[25] The representations of the schwaless output in (36a) and (24a) would then be as in (37) and (38). Notice that this leaves unexplained why initial /r/ before a glide can be licensed extrasyllabically at the PW level whereas other initial consonants, like those in (24), can only be so licensed phrase-initially.

(36)   OPTIONAL SCHWA WORD-INITIALLY BEFORE /r/+GLIDE SEQUENCES:
    a. *aime rien*    'like nothing'    /ɛm rjɛ̃/    [ɛm(ə)rjɛ̃]
    b. *Patrick Roy*    (name)    /patrik rwa/    [patrik(ə)rwa]

(24)   OPTIONAL SCHWA AFTER PHRASE-INITIAL CONSONANTS:
    a. *le salut*    'the greeting'    /l=saly/    [l(ə)saly]
    b. *te fais pas de bile*    'don't worry'    /t=fɛ pa d=bil/    [t(ə)fɛpadbil]
    c. *demande-la*    'request it'    /dəmãd la/    [d(ə)mãdla]
    d. *je suis*    'I am'    /ʒ=sɥi/    [ʒ(ə)sɥi] [ʃsɥi]

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[25]This extension requires discussion of an additional point. I mentioned above that there are no word-internal [Crj] sequences. But internal [Crw] and [Crɥ] sequences are found, as in *endroit* 'location' [ãdrwa] and *autrui* 'others' [otrɥi]. The preceding consonant, however, can only be a stop or /f/, that is exactly the consonants that precede /r/ in complex onsets. We adopt the hypothesis that in these words (and others like *surcroît* 'addition' [syr.krwa]) the glide forms a diphthong with the following vowel and is not in onset position (Noske 1982, 1988; Rialland 1986). Crucially, the glide option is not available in words like *roi* 'king' [rwa]. This is consistent with the fact that schwa cannot usually appear before words beginning with an /OrG/ sequence: *Patrick Droit* [pa.trik.drwa] *[patrikədrwa] contrasts with *Patrick Roy* [pa.trik.r.wa] [pa.tri.kər.wa] (36b). In the first example the word-initial sequence [dr] is fully syllabified in the onset, and [w] in the nucleus; in the second case [w] is in the onset and [r] is extrasyllabic.

(37)   EXTRASYLLABICITY OF WORD-INITIAL /r/ FOLLOWED BY A GLIDE:
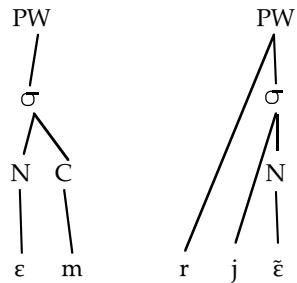


(38)   EXTRASYLLABICITY OF PHRASE-INITIAL CONSONANTS:
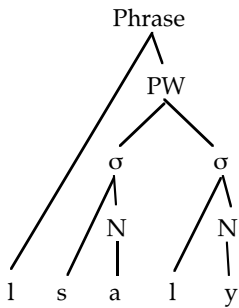


Allowing for extrasyllabicity significantly increases the empirical adequacy of the syllabic approach to the distribution of schwa based on the assumptions in (29). The main elements of the system developed so far can be summarized as follows:

(39)   MAIN ELEMENTS OF THE SYLLABIC APPROACH:
   a.   French allows only one coda consonant. Complex onsets are tolerated.
   b.   Consonants cannot resyllabify across a boundary or deleted schwa.
   c.   Extrasyllabic consonants are allowed word-finally.
   d.   Extrasyllabic consonants are allowed phrase-initially (and word-initially in /r/+glide sequences).

All the cases where schwa is obligatory are accounted for, as well as its freer behavior word-finally and phrase-initially. There remains, however, an important body of data that is, I believe, truly problematic for the syllabic analysis. These involve clitics and morpheme-internal schwas. The proposal summarized in (39) excludes pronunciations that are well attested and for which I do not see a reasonable solution. These are presented and discussed in the coming section.

### 2.2.2.3. Problematic cases: clitics and morpheme-internal schwas

Consider the following clitic boundaries, in which epenthesis fails to apply (40), and polysyllabic morphemes, in which the underlying schwa in the first syllable deletes (41). All these outputs contain sequences of 3 or 4 consonants, in which the middle consonant(s) cannot be licensed with the mechanisms in (39), by direct syllabification or through extrasyllabicity. These consonants are underlined in the examples. For these examples I have not given all the possible pronunciations but only those that are problematic for the system described in (39). For the example in (40d), there are actually no fewer than four such possibilities.

(40)   NO SCHWA EPENTHESIS AT CLITIC BOUNDARIES IN /C C=C/ CONTEXTS:
   a.   *chef de la gare*            /ʃɛf d=la=gar/          [ʃɛfdlagar]
        'master of the station'
   b.   *Paul se rasait*            /pɔl s=razɛ/            [pɔlsrazɛ]
        'P. was shaving'
   c.   *(il) faut que je la vois*    /fo k=ʒ=la=vwa/    [fokʒlavwa]
        'I have to see her'
   d.   *tu veux que je te le dise*    /ty=vø k=ʒ=t=l=diz/   i.  [tyvøkəʃtlədiz]
        'you want me to say it to you'                       ii.  [tyvøkʃtələdiz]
                                                            iii. [tyvøkʃtəldiz]
                                                            iv.  [tyvøkʃtlədiz]
   e.   *tu crois qu'il faut que je fasse tout?*      (from Rialland 1986)
        'you think that I have to do everything?'
                    /ty=krwa k=il=fo k=ʒ=fas tu/     [tykrwakilfokʃfastu]

(41)   SCHWA DELETION IN TINITIAL SYLLABLES IN /C CəC/ CONTEXTS:
   a.   *sept fenêtres*    'seven windows'          /sɛt fənɛtr/          [sɛtfnɛtr]
   b.   *une chemise*      'a shirt'                /yn ʃəmiz/            [ynʃmiz]
   c.   *tu devenais*      'you were becoming'      /ty=dəvənɛ/          [tydvnɛ]
   d.   *Jacques devrait (partir)*  'J. should (leave)'  /jak dəvrɛ/       ?[jakdvrɛ]

Readers familiar with the facts on schwa may notice that some of these outputs, or similar ones, have not been unanimously accepted in the literature. The pronunciation given in (41c), for instance, is rejected by Anderson (1982) and Noske (1982, 1988, 1993, 1996). The latter also declares (41d) unacceptable. Tranel (1987a) contrasts *la fenêtre* [lafnɛtr] and *une fenêtre* [ynfənɛtr]. He does not explicitly reject [ynfnɛtr], which is parallel to (41a), as a possible pronunciation for *une fenêtre*, but his discussion may implicitly suggest that. A similar contrast is given by Fischer (1980).

I do not believe the judgments given in (40)-(41) are problematic. Supporting evidence for the examples in (40) and (41) is not hard to find, and the judgments reported in the preceding paragraph will be discussed in section 2.2.3. The form in (40a) appears in Lyche & Durand (1996) (see also Charette 1991), one identical to (40d-iv) in Neidle (1979). (40e) comes from Rialland (1986). The contrast between [lafnɛtr] and [sɛtfnɛtr] or [ynfnɛtr], with schwa deletion in all cases, is real in that deletion is more likely in the first form, where *fenêtre* follows a vowel-final determiner. But the other two are certainly not impossible, and this is made clear in e.g. Dell (1973/1980/1985), whose pronunciation is in general rather conservative, Morin (1978), Charette (1991), or Lyche & Durand (1996). All statistical studies of spontaneous or monitored speech also show abundant examples of comparable clusters involving clitics or morpheme-initial syllables with an underlying schwa: Dauses (1973); Bazylko (1976); Malécot (1976); Léon (1987); Gadet (1997) (see also van Eibergen (1992) and van Eibergen & Belrhali (1994) for similar examples in Grenoble French).

Granting the grammaticality of the examples in (40)-(41), let us now see their implications for a syllabic approach to the distribution of schwa. The underlined consonants cannot be licensed if one adopts the assumptions in (39). To show this I will use the example in (40e), [tykrwakilfokʃfastu]. This output contains a cluster [kʃf], in which the middle [ʃ] is problematic. There are three possibilities for its licensing, which all fail.
- First, it cannot be licensed as a coda because codas in French may contain no more than one consonant (39a), and the coda preceding [ʃ] is already exhausted by [k].
    → Hence the ungrammaticality of *[...okʃ.fa...].
- Second, it cannot resyllabify with the following consonant [f] and form a complex onset with it because resyllabification across a boundary is prohibited (39b).
    → Hence the ungrammaticality of *[...ok.ʃfa....]
- Third, it cannot be licensed by phrase-initial or word-final extrasyllabicity because it does not appear in one of these positions.
    → Hence the ungrammaticality of *[...ok.ʃ.fa...]
A schwa should therefore automatically be inserted to license [ʃ], but this is not the case. The same reasoning applies to all the other cases. The last output in (40d-iv) is even more dramatic, as it contains a four-consonant cluster in which the two middle ones cannot be licensed in the preceding coda, the following onset, or through extrasyllabicity.

I do not see what additional assumptions or amendments could save these and other comparable examples. One could relax assumption (39b) that prohibits

resyllabification across a boundary or deleted schwa. The underlined consonants would then be allowed to resyllabify to the right and form complex onsets with the following consonants.[26] This solution will simply not work. In each of the clusters which the unlicensed consonant is part of in (40) and (41), the last two consonants do not form a legitimate onset. Consider again the [kʃf] sequence in (40d). I believe the most liberal assumptions about the set of permissible onsets in French would not include [ʃf] among them. In other sequences in (40)-(41), perhaps [lsr] in (40b) or [nʃm] in (41b), the last two consonants could be more reasonably accepted as complex onsets (i.e. [sr] and [ʃm]). This would allow the middle fricative to be licensed by forming a complex onset with the following segment. But this would not change the nature of the problem.

Extending the domain of extrasyllabicity by allowing it to apply to the unlicensed consonants in (40) and (41) will obviously not work either. It is hard to see how we could constrain extrasyllabicity in such a way that it could apply in certain segmental contexts but not in others, in order to get the necessary distinction between obligatory and optional schwas at clitic boundaries and morpheme-internally. For example, let us allow the syllabification [sɛt.f.nɛtr] for (41a), repeated in (42a), with an extrasyllabic [f] attached directly to the following prosodic word. Then what rules out the equivalent syllabification *[sɛt.d.mãd] in (42b), with an extrasyllabic [d]? Yet this representation must be excluded since the form is unacceptable (or at best quite marginal) without schwa. The same reasoning applies to (40a), repeated in (42c), versus (42d). If the [d] of [ʃɛf.d.la.gar] is extrasyllabic, why can't *the same [d]* be also extrasyllabic, or only marginally so, in the similar form in (42d) ??[ʃɛf.d.sa.gar]?[27]

(42)    SEGMENTALLY-BASED CONTASTS IN THE ACCEPTABILITY OF SCHWA OMISSION:
    a. *sept fenêtres*      'seven windows'            /sɛt fənɛtr/          [sɛtfnɛtr]
    b. *sept demandes*      'seven requests            /sɛt dəmãd/          *[sɛtdmãd]
    c. *chef de la gare*    'master of the station'    /ʃɛf d=la=gar/        [ʃɛfdlagar]
    d. *chef de sa gare*    'master of his station'    /ʃɛf d=sa=gar/        ??[ʃɛfdsagar]

I doubt that extrasyllabicity can provide a viable and well-motivated solution to the forms in (40)-(41). For these schwaless outputs to be grammatical, then, the

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[26]This would obviously create a problem for the forms for which this assumption was crucially needed, like *garderie* in (32b), but suppose there is an alternative way to force schwa insertion in such cases.

[27]It has also been suggested that some of the unsyllabifiable consonants in (40) and (41) are in fact syllabic and occupy the nucleus of the syllable, e.g. Bouchard (1981), Rialland (1986). But the contexts in which consonants may become syllabic have not been defined. Again, if the [d] is syllabic in (42c), it should also be in (42d).

consonant clusters they contain have to be exhaustively syllabified. The only way to achieve this is by adopting a more permissive definition of a possible syllable in French. This brings us back to Pulgram's (1961) proposal, in which *all* attested word-initial and word-final sequences form acceptable onsets and codas. We saw why this approach was not restrictive enough. But the main point here is that even this highly liberal characterization of a well-formed syllable cannot generate the forms in (40)-(41). The clusters which the underlined (unsyllabifiable) consonants are part of cannot be decomposed into an attested coda-onset sequence. Consider again the [kʃf] sequence in (40d): [kʃ] is not an attested word-final sequence, [ʃf] not an attested word-initial one. Even Pulgram, then, predicts schwa to be obligatory here. This contrasts with the otherwise overgenerating power of his proposal. The conclusion I draw from this discussion is that analyses based on exhaustive syllabification are bound to undergenerate the attested facts, that is predict schwa to be obligatory where it is not, as in (40)-(41).

### 2.2.3. Schwa and variability

A general weakness of syllabic treatments which I have not yet mentioned is their failure to account for the omnipresent and inherent variability of the process of schwa insertion/deletion. They offer a rule that determines when schwa is obligatory, but they are silent on the much more numerous cases where schwa is not obligatory. They generally assume that, if not required, schwa is optional in all the positions in which it could in principle be found (that is at every juncture flanked on each side by a consonant and when an underlying schwa is posited). This assumption is unsatisfactory for at least two reasons. First, I consider schwa to be excluded in many contexts, at least under normal linguistic circumstances. These contexts comprise the C-C environment word-internally (43a-b) and at word boundaries (43c), as well as the C-CC environment at word boundaries with some sequences of consonants (43d). These contexts should be described and distinguished from the domain of optional schwas.

(43)    /C-C(C)/ contexts where schwa is normally excluded:
        Before derivational suffixes:
   a.  *fruiterie*  'fruit store'          /frɥit+ri/      [frɥitri]   *[frɥitəri]
        Before future/conditional endings (other than 1st/2nd plural cond):
   b.  *gâterai*  'spoil+FUT.1SG'      /gat+re/       [gatre]     *[gatəre]
        At word boundaries:
   c.  *attaque pénible* 'painful attack'  /atak penibl/   [atakpenibl]  *[atakəpenibl]
   d.  *attaque frontale* 'frontal attack'  /atak frɔtal/   [atakfrɔtal]  *[atakəfrɔtal]

Second, within this optional domain we find all degrees of likelihood and naturalness for the presence of a schwa, from the very marginal to the almost obligatory. As Cornulier (1975: 105) puts it: "A chaque instant, il existe entre l'élision obligatoire et l'impossible, une infinité mouvante de degrés qu'il est absurde de quantifier en quelques nombres entiers. Tel est le continu qui échappe, par essence, à la réduction à une combinatoire abstraite de phonèmes discrets et alignés." This continuum is based in part on independent phonological and morphological factors (disregarding the sociolinguistic ones), and any theory of schwa should identify and integrate them.[28]

I believe it is in part the failure to recognize this variability that has led to judgments marking as ungrammatical some of the forms in (40) and (41) above. Recall for example that (41c) is rejected by Anderson (1982) and Noske (1982, 1988, 1993, 1996), who also declares (41d) unacceptable. The interpretation of such judgments brings us to two major generalizations about the distribution of schwa, which I call the *loi des deux consonnes* (after Leray 1930) and the "law of alternating schwas". These have become commonplaces of the literature on this topic, and it is worthwhile to see their effect on the distribution of schwa, where they come from, and how they are and should be interpreted.

The *loi des deux consonnes* states that a schwa is pronounced in every potential site (i.e. boundary or underlying schwa) that is preceded by two consonants. So inputs of the form /CC*C/ surface as [CCəC]. The law of alternating schwa is just a subcase of the *loi des deux consonnes*: it states that in a series of potential sites separated by one consonant, a schwa is pronounced in at least every other site. So in inputs like /C*C*C*C.../, schwa is not omitted in two consecutive sites.[29] It is easy to see that the law of alternating schwas follows from the *loi des deux consonnes*. Consider any sequence of two potential sites in a row /C*C*C/. If schwa is omitted in the first one, which is indicated by the underlined gap, the second one is necessarily preceded by two consonants, as shown in the form [C_C*C]. The *loi des deux consonnes* then predicts that schwa cannot be omitted in the second site as well.

These pronunciation laws are described in the classic sources on the pronunciation of "Standard" French, e.g. Grammont (1914/1961) and Fouché (1959).

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[28]As we will demonstrate in more detail below, Pulgram (1961: 307-308) is wrong when he writes: "The choice in the optional cases, however, is not determined by distributional factors, but has to do with the style employed by the speaker (...)."

[29]Considering all schwas underlying, these generalizations transpose as follows: schwa surfaces if preceded by more than one consonant; in sequences of consecutive schwas separated by one consonant (CəCəCə...), at least every other schwa is pronounced.

But it is clear that they should be interpreted as tendencies rather than absolute laws. First, what is often overlooked about these sources is that they are in large part written for foreigners who want to acquire a correct pronunciation of French. The intention is not to describe every grammatical form in French but the rules of an average correct pronunciation (see Morin 1987a). As Fouché (1959: iv) writes: "Loin de nous la pensée que telle ou telle prononciation passée sous silence ne soit pas la bonne. Mais on ne commettra pas de faute en s'en tenant à celles qui sont notées ici." It is indeed true that if one adopts a distribution of schwa that obeys the *loi des deux consonnes*, the resulting pronunciation always sounds appropriate and natural among educated speakers. It represents an average careful pronunciation. But one should not conclude that forms that do not conform to the *loi des deux consonnes* are unacceptable or unattested. Second, Grammont and Fouché themselves mention a number of counterexamples to their generalizations, which have been surprisingly disregarded in later works. Dell's (1973/1980/1985) work is similar in that it designs a system that basically enforces these two "laws", but also cites exceptions, which he does not integrate into his analysis.

Even though I believe the status of the two laws as tendencies is quite clear in Grammont or Fouché, one can observe a temptation in phonological analyses to interpret them as absolute rules and consider all "deviant" forms as ungrammatical (at least in careful speech). This dichotomization of the data based on the *loi des deux consonnes* is apparent, for instance, in Selkirk (1978), Anderson (1982), and Noske (1993). The clearest example is found in Anderson (1982: 542), who cites the sentence in (44) with four consecutive sites for schwa, three clitic boundaries followed by an underlying schwa. In each site schwa may or may not be pronounced, which yields sixteen possible outputs. Eight of them, those in the left column, obey the *loi des deux consonnes* in that a schwa is pronounced in at least every other site. The eight outputs in the right column violate it.

(44)    *envie de te le demander*    'desire to you it ask'    /ãvi d=t=l=dəmãde/
        Conform to the *loi des 2 consonnes*        Violate the *loi des 2 consonnes*
        a.    [ãvi dətələdəmãde]            i.        *[ãvi dət_l_dəmãde]
        b.    [ãvi dətələd_mãde]            j.        ??[ãvi dətəl_d_mãde]
        c.    [ãvi dətəl_dəmãde]            k.        [ãvi d_t_lədəmãde]
        d.    [ãvi dət_lədəmãde]            l.        *[ãvi d_t_l_dəmãde]
        e.    [ãvi d_tələdəmãde]            m.        [ãvi d_t_ləd_mãde]
        f.    [ãvi dət_ləd_mãde]            n.        ??[ãvi d_t_təl_d_mãde]
        g.    [ãvi d_təl_dəmãde]            o.        *[ãvi dət_l_d_mãde]
        h.    [ãvi d_tələd_mãde]            p.        *[ãvi d_t_l_d_mãde]

Anderson claims that only the outputs that conform to the *loi des deux consonnes* are grammatical. He then comments: "Of course, not all eight possible pronunciations are equally likely. Nonetheless, all are PHONOLOGICALLY possible, as opposed to the inadmissibility of any pronunciation with two consecutive schwas deleted." Things are not so clear cut, however. I indicate in (44) possible acceptability judgments for the eight pronunciations that violate the *loi des deux consonnes*. Four of them are indeed impossible (i, l, o, p). Two of them may not be completely impossible but certainly marginal (j, n). But crucially, those in (44k) and (44m) are quite acceptable. In my Montréal French idiolect, the pronunciation [ãvidtl̪ədmãde] (44m), with schwa omitted in two consecutive sites, is probably in fact the most natural pronunciation of this sentence. I conclude that there is no justification for considering the *loi des deux consonnes* as an absolute phonological factor in the distribution of schwa.

We can now understand the origin of the ungrammaticality judgments assessed by Anderson and Noske to some of the forms in (40) and (41). We readily see that these examples all contradict the *loi des deux consonnes*: in each case schwa fails to appear in a position that is preceded by two consonants. I do not exclude the possibility that the *loi des deux consonnes* really is absolute for some speakers (who I do not know), hence these authors's judgments. But I would rather interpret their judgments as stemming from a certain polarization and idealization of the data, which favors the ungrammaticality judgments attributed to all forms that disobey the *loi des deux consonnes*.[30]

More generally, any theory constrained in such a way that it is impossible to depart from the *loi des deux consonnes* and the law of alternating schwas is on the wrong track. The syllabic approach presented in section 2.2.2.1, based on the assumptions in (29a) (no complex codas) and (29b) (no resyllabification across boundaries and deleted schwas) is such a theory. These two assumptions, as we have seen, necessarily predict that a schwa appears at any potential site for schwa that is preceded by two consonants. In an input /$C_1C_2$*$C_3$/, $C_2$ cannot be properly syllabified in the preceding coda (29a) or the following onset (29b) and requires an additional vowel to be licensed. And dismissing forms not conforming to the *loi des deux consonnes* as part of a different, sub-standard, dialect is certainly not a solution. The distribution of schwa is highly variable. There is a continuum of acceptability and frequency of schwa omission/insertion, and nowhere can we establish clear

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[30]I believe this polarization may be partly related to the fact that phonological theory has generally not felt comfortable with variability. The search for clear patterns can certainly be associated with an observed tendency, on the part of analysts, to attempt (consciously or not) to limit and reduce variation.

borders between what could be considered standard and non-standard patterns. I believe an acceptable theory of the distribution of schwa has to derive these preferences; there is no point in idealizing the facts.

## 2.2.4. A FLEXIBLE APPROACH TO SYLLABLE WELL-FORMEDNESS?

Acknowledging the variability of the distribution of schwa and the need for more flexibility, Morin (1974), Cornulier (1975), Tranel (1987a, 1999, 2000) and, to some extent, Bouchard (1981), suggest that the full range of facts cannot be generated with a rigid definition of the French syllable. It follows from their suggestion that the two following assumptions, which were implicit in the previous discussion, have to be dropped: 1. the definition of a possible syllable depends on the patterns independently attested in the language, and 2. this definition is fixed across prosodic and morphological contexts. That is, we have to adopt a flexible notion of the syllable and define it on the basis of criteria other than the phonotactic patterns observed in the lexicon. This is expressed in the following quotes:

> Much of the burden of the analysis ultimately rests on an adequate account of syllable structure in French, in particular on a detailed understanding of allowed onsets and codas. The possible content of these syllable constituents may differ word-internally and at word's edge, within words and across words, in different syntactic contexts, in different styles, across dialects, and across speakers. The variability typically observed in so-called 'schwa deletion' is rooted in these variations (…). (Tranel 1987a: 859-860)

> Le fait qu'entre les emplois obligatoires et les emplois interdits d'e, il existe des emplois plus ou moins évitables ou imposés reflète le fait qu'entre une séquence impossible et une séquence très facile à syllaber, toutes les nuances sont concevables. (Cornulier 1975: 115)

> Un schwa (…) peut tomber si la syllabe précédente est non saturée. Une syllabe fermée est en général saturée, sauf dans certains cas qui font intervenir la nature des ajouts consonantiques, des frontières et des segments voisins, de la tonique, de sa position dans l'énoncé (position finale absolue ou non), etc. (Morin 1974: 83 and 88)

An analysis based on a flexible approach to the syllable and context-dependent syllable well-formedness, however, remains to be developed. The authors cited above did not go beyond mere suggestions, exhaustively contained in

the preceding quotes. In more recent work, Tranel (1999, 2000), working in Optimality Theory, offers the first glimpse of what a flexible-syllable analysis of the distribution of schwa would look like. He resorts to universal syllable well-formedness conditions, and analyzes a very limited set of facts about schwa in terms of a "universal hierarchy of complex onset/coda goodness", without recourse to a French-specific definition of the syllable. This hierarchy is determined by only one factor: the Sonority Sequencing Principle. The SSP states, for instance, that [sp-] is a better onset than [lp-]; this accounts for the fact that schwa omission, although possible in both cases, is more acceptable in *ce panneau* 'this panel' [spano] than in *le panneau* 'the panel' [lpano] phrase-initially. A more complete account would have to include many more factors. To see what kind of other elements it would contain, consider again the two pairs of examples in (42), repeated below.

(42)    SEGMENTALLY-BASED CONTASTS IN THE ACCEPTABILITY OF SCHWA OMISSION:
    a.  *sept fenêtres*    'seven windows'    /sɛt fənɛtr/    [sɛtfnɛtr]
    b.  *sept demandes*    'seven requests    /sɛt dəmãd/    *[sɛtdmãd]
    c.  *chef de la gare*    'master of the station'    /ʃɛf d=la=gar/    [ʃɛfdlagar]
    d.  *chef de sa gare*    'master of his station'    /ʃɛf d=sa=gar/    ??[ʃɛfdsagar]

These examples contain one possible site where schwa could surface: the underlying schwa in (42a-b) and the first clitic boundary in (42c-d). Schwa omission yields a three-consonant cluster, underlined in the phonetic representation. This cluster has to be properly syllabified if the form is to be acceptable. This is possible for (42a) and (42c), which are perfectly grammatical, but not for (42b) and (42d). In each case the potentially unsyllabifiable consonant is the middle one ([f] in (42a), [d] in the other three cases), since the first and last consonants automatically occupy the preceding coda and the following onset, respectively. The clusters in (42a-b) only differ in the nature of the middle obstruent: a fricative [f] in (42a), a stop [d] in (42b). Since only [f] is syllabifiable here, our theory would presumably have to contain a statement like "fricatives are more easily syllabified than stops between two consonants". As for the sequences in (42c-d), they contrast in the identity of the third consonant: [l] in (42c), [s] in (42d). A possible conclusion, which our analysis would also have to incorporate, is that "stops are more easily syllabified before a liquid than before an obstruent."

Other similar contrasts could be examined and the relevant difference integrated into statements on possible syllabifications, or relative ease of syllabification. This approach could certainly be made to work. But my objection to it is that it makes the syllable meaningless. Such statements, including the SSP, can be formulated independently of the syllable and their only use in French would be to

account for the behavior of schwa. The advantages of the syllable then become unclear. In fact, the syllabic rules proposed for the contrasts in (42) – "fricatives are more easily syllabified than stops between two consonants" and "stops are more easily syllabified before a liquid than before an obstruent" – follow straightforwardly from two of the sequential generalizations we have established in the preceding chapter: stops, more than other consonants, want to appear next to a vowel, and so do consonants that are relatively similar to an adjacent segment. This explains why [d] is more likely to trigger schwa insertion  than [f] (42b vs. 42a) and why it is more likely to do so before another obstruent, a relatively similar segment, than before a liquid, a more contrasting one (42d vs. 42c). More generally, I believe a large portion of the data on the distribution of schwa can be accounted for with the generalizations proposed for the Hungarian, English, and Icelandic deletion patterns examined in chapter 1, and I do not see what additional work the syllable could do. These generalizations concern 1. the role of adjacent vowels, 2. the SSP, 3. the greater vulnerability of stops, 4. the desirability of contrast, 5. the continuancy value of the segment following a stop, and 6. the effect of the adjacent prosodic boundary. I discuss each of these factors in turn in section 2.3.

## 2.3. SEQUENTIAL GENERALIZATIONS

### 2.3.1. ADJACENCY TO VOWELS

| *Generalization 1:* | Consonants want to be adjacent to a vowel, and preferably followed by a vowel. |
|---|---|

The distribution of schwa is obviously conditioned by the desirability for consonants to be adjacent to a vowel. This will be demonstrated by looking at the various contexts in which schwa can appear, and showing that adjacency to vowels affects its distribution in systematic ways. First, underlying schwas are never found next to a vowel, as noted earlier. Second, schwa cannot be inserted in a position that is already adjacent to a vowel; see the data in (3) above. That is, in contexts C-V, V-C, and V-V, where "-" indicates any boundary, epenthesis never takes place. The reason is that epenthesis would not affect the position of consonants with respect to adjacent vowels: a prevocalic consonant C-V would just remain prevocalic if schwa were added (CəV); likewise for V-C and V-V.

Things become interesting with potential sites that are flanked by consonants on both sides.[31] I distinguish three cases, as in table 3: /VC*CV/, /VCC*CV/, and /VC*CCV/. In the first case, both consonants are adjacent to a vowel; the other two contain a sequence of three consonants in which the middle one is not adjacent to any vowel. We therefore expect schwa to be more likely to appear in the last two contexts than in the first one, since it serves to provide every consonant with a flanking vowel. This is indeed the case. As a first generalization, one can observe by looking at table 3 that schwa is never required in a /VC*CV/ context, that is in a position where the surrounding consonants are either followed or preceded by a vowel. It is only in /VCC*CV/ and /VC*CCV/ sequences that schwa insertion/retention may be obligatory.

Let us look now at each morphological context separately, and see how adding a consonant on either side of the site affects the likelihood of schwa. The relevant data are given in the table below, which indicates for each combination of a morphological context and a segmental context whether schwa is excluded, optional, or obligatory, with an example taken from table 3.

The effect systematically goes in the expected direction: in each morphological context moving from /VC*CV/ to /VCC*CV/ or from /VC*CV/ to /VC*CCV/, that is from the second to the third column, results in an increased likelihood of schwa. The difference is usually qualitative: from excluded or optional in /VC*CV/ schwa becomes optional or obligatory in /VC*CCV/ or /VCC*CV/, at least for a subset of the possible combinations of consonants. In two cases, at clitic boundaries and morpheme-internally, there is no qualitative difference in the likelihood of schwa between /VC*CV/ and /VC*CCV/ sequences: schwa is just optional in both contexts.[32] We will see, however, that there is a clear frequency effect: schwa more readily appears in sequences of three consonants.

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[31] Recall that there is no utterance-initial or utterance-final epenthesis in the variety under consideration. This can be explained in terms of the strength of the prosodic boundary. This aspect of the data is investigated in section 2.3.6; until then I limit my attention to utterance-internal positions.

[32] One obvious question is: What distinguishes clitics and morpheme-internal positions, where schwa is optional in /VC*CV/, from the other contexts, where it is normally excluded if there is only one consonant on each side? The fact that morpheme-internal schwas are always optional is to be related to the underlying status of schwa in this context. Underlying schwas surface more readily than epenthetic ones in the same environment. As for clitic boundaries, I suggest that the presence of schwa in these positions is favored, independently of the segmental constraints, by the desirability for every morpheme to conform to a minimal CV form.

<u>Table 4</u>:
**Likelihood of schwa in /VC\*CV/ vs. /VCC\*CV/ and /VC\*CCV/**

| Context | VC\*CV | VC\*CCV - VCC\*CV | | |
|---|---|---|---|---|
| Before derivational suffixes | *excluded* <br> (5) /frɥit+ri/→[frɥitri] | C\*CC <br> CC\*C | N/A <br> *obligatory* | (15) /gard+ri/→[gardəri] |
| Before future/cond endings | *excluded* <br> (6) /gat+re/→ [gatre] | C\*CC <br> CC\*C | *obligatory* <br> *optional* <br> *obligatory* | (10) /gat-rje/→[gatərje] <br> (17) /gard+re/→[gard(ə)re] <br> (16) /dubl+re/→[dubləre] |
| At clitic boundaries | *optional* <br> (7) /ani l=saly/→[anil(ə)saly] | C\*CC <br><br> CC\*C | *optional* <br><br> *optional* <br> *obligatory* | (11) /ani l=grɔ̃dɛ/→[anil(ə)grɔ̃dɛ] <br> /plɛ̃ d=psikɔlɔg/→[plɛ̃d(ə)psikɔlɔg] <br> (20) /ɛstɛr l=saly/→[ɛstɛrl(ə)saly] <br> (19) /anik l=saly/→[anikləsaly] |
| At word boundaries | *excluded* <br> (8) /atak penibl/→[atakpenibl] | C\*CC <br><br> CC\*C | *optional* <br> *excluded* <br> *optional* | (13) /ɛm rjɛ̃/→[ɛm(ə)rjɛ̃] <br> (12) /atak frɔ̃tal/→ [atakfrɔ̃tal] <br> (21) /akt penibl/→ [akt(ə)penibl] |
| Morpheme-internally | *optional* <br> (9) /la=fənɛtr/→[laf(ə)nɛtr] | C\*CC <br> CC\*C | *optional* <br> *optional* <br> *obligatory* | (14) /la=səkretɛr/→[las(ə)kretɛr] <br> (23) /yn fənɛtr/→ [ynf(ə)nɛtr] <br> (22) /yn dəmɑ̃d/→[yndəmɑ̃d] |

For the last three contexts – at clitic and word boundaries and morpheme-internally – one may nevertheless observe an asymmetry between /VC\*CCV/ and /VCC\*CV/, the latter favoring schwa insertion/retention more than the former. At clitic boundaries and morpheme-internally, schwa may be obligatory in the sequence /VCC\*CV/ but not /VC\*CCV/. At word boundaries, schwa insertion is always optional in /VCC\*CV/ but is normally excluded with some combinations of /VC\*CCV/, as it normally is in /VC\*CV/. This asymmetry has led most authors, since Grammont (1914 / 1961), to claim that the distribution of schwa really depends on the number of preceding consonants.[33] Under this view, the behavior of the 1st/2nd plural conditional endings, which triggers obligatory schwa in the context /VC\*CCV/, is treated as an exception. I believe it should not be and that the emphasis put on the number of preceding consonants led to certain contrasts based on the number of following consonants (/VC\*CV/ vs. /VC\*CCV/) being overlooked.

First, Charette (1991) notes a stronger tendency to pronounce a schwa in the initial syllable of polysyllabic morphemes when it is *followed* by a consonant cluster /CəCCV/ (45), as opposed to when it is followed by only one consonant /CəCV/ (46).

(45)    UNDERLYING SCHWA IN /CəCCV/:
     a.   *secrétaire*      'secretary'      /səkretɛr/
     b.   *secret*      'secret'      /səkrɛ/
     c.   *regret*      'regret'      /rəgrɛ/
     d.   *degré*      'degree'      /dəgre/
     e.   *chevreuil*      'roe deer'      /ʃəvrœj/
     f.   *depuis*      'since'      /dəpɥi/
     g.   *besoin*      'need'      /bəzwɛ̃/

(46)    UNDERLYING SCHWA IN /CəCV/:
     a.   *seconde*      'second'      /səgɔ̃d/
     b.   *semaine*      'week'      /səmɛn/
     c.   *demande*      'request'      /demɑ̃d/
     d.   *repas*      'meal'      /rəpa/
     e.   *cheveu*      'hair'      /ʃəvø/

This tendency is confirmed in Hansen's (1994) study on the frequency of schwa in morpheme-initial syllables. Among the 25 most frequent words containing a schwa in their initial syllable in Hansen's spoken corpus, there are 17 words with the sequence /CəCV/ and 8 with the sequence /CəCCV/. The average rate of schwa retention is 59% for /CəCCV/ words like those in (45), as opposed to only 34% for /CəCV/ ones (46).[34] Unfortunately, I know of no comparable numbers in contexts other than morpheme-internally where schwa is always at least optional.

Second, a schwa is more likely to appear at a clitic boundary in the context /...V $C_1 = C_2 C_3 V$.../ than in the context /...V $C_1 = C_2 V$.../, that is preceding two rather than one consonant, at least with most combinations of $C_2$ and $C_3$. Consider the following data. In all cases schwa can be omitted, but speakers' intuitions indicate that omission is much more likely in (48), where the clitic is followed by only one consonant, than in (47), where the clitic is followed by a word-initial cluster, e.g. [ps], [pn] or [sp]. In the latter case omission of schwa yields a consonant not adjacent to a vowel, in contrast to the former. Thus, adjacency to a vowel holds for both /VC=CCV/ and /VCC=CV/.

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[33]Only Fouché (1959) notices the effect of the following segments, as he distinguishes between the CC\*C and CC\*CC contexts at word boundaries, schwa being generally absent in the first case but present in the second. If schwa deletes in CC\*C, it also does in C\*CC, since this context is generally less favorable to schwa.

[34]Interestingly the words in (45), except for *depuis*, have all been reanalyzed with a stable vowel in Québec French, at least in my own idiolect, so that the initial vowel never deletes.

(47)   SCHWA AT CLITIC BOUNDARIES IN /V C*CCV/ CONTEXTS:
 a.   *plein de psychologues*  /plɛ̃ d=psikɔlɔg/  [plɛ̃d(ə)psikɔlɔg]
   'full of psychologists'
 b.   *plein de pneumologues*  /plɛ̃ d=pnømɔlɔg/  [plɛ̃d(ə)pnømɔlɔg]
   'full of chest specialists'
 c.   *plein de spéléologues*  /plɛ̃ d=speleɔlɔg/  [plɛ̃d(ə)speleɔlɔg]
   'full of speleologists'
 d.   *plein de Srilankais*  /plɛ̃ d=srilãkɛ/  [plɛ̃d(ə)srilãkɛ]
   'full of people of Sri Lanka'

(48)   SCHWA AT CLITIC BOUNDARIES IN /V C*CV/ CONTEXTS:
 a.   *plein de neurologues*  /plɛ̃ d=nørɔlɔg/  [plɛ̃d(ə)nørɔlɔg]
   'full of neurologists'
 b.   *plein de pédiatres*  /plɛ̃ d=pedjatr/  [plɛ̃d(ə)pedjatr]
   'full of pediatricians'

The same effect can be found at word boundaries, with the difference that a schwa in the segmental context /VC-CV/ is marked, except under strong emphasis.

(49)   SCHWA AT WORD BOUNDARIES IN /VC*CCV/ VS. /VC*CV/ CONTEXTS:
 a.   *lutte psychologique*  /lyt psikɔlɔʒik/  [lyt(ə)psikɔlɔʒik]
   'psychological battle'
 b.   *truc mnémotechnique*  /tryk mnemotɛknik/  [tryk(ə)mnemotɛknik]
   'mnemotechnic trick'
 c.   *lutte sensationnelle*  /lyt sãsasjɔnɛl/  [lyt(??ə)sãsasjɔnɛl]
   'sensational battle'
 d.   *truc mirobolant*  /tryk mirɔbɔlã/  [tryk(??ə)mirɔbɔlã]
   'wonderful trick'

As the reader has probably already noticed, I have not used in (47) and (49) word-initial stop+liquid or /f/+liquid clusters. These indeed appear to behave more like single consonants at clitic and word boundaries, and contrast with basically all the other attested word-initial clusters: fricative+stop (47c), stop+fricative (47a, 49a), stop+nasal (47b), nasal+nasal (49b), and fricative+liquid (other than /fr, fl/) (47d). A more systematic comparison of all the initial clusters is needed, but my point here is simply to show the potential effect of the consonants following the boundary. The reasons for the distinct behavior of initial stop+liquid (except /tl, dl/) and /f/+liquid clusters remain to be clarified, but I believe important factors are the enhancing effect of the word-initial position, as schwa appears less likely in /C*CC/ than in

/CC*C/ only if the middle consonant is word-initial, and contrast. The favored sequences, those that do not need the presence of schwa, tend to show a big contrast in manner of articulation and avoid homorganicity ([fl] being better than [sl], [kl]/[gl]/[pl]/[bl] being better than [tl]/[dl]). How this interacts with the status of /r/ (see the following section) is unclear. This is an issue I leave for future research, which I believe would be enlightened by a detailed study of segmental overlap in these various sequences.

  I have shown in this section that the behavior of schwa is driven by the desirability for consonants to be adjacent to a vowel. Schwa is generally omitted when it is not required to meet this condition. Priviledged contexts for the appearance of schwa are therefore triconsonantal clusters, in which the middle consonant is in need of a flanking vowel. But not all such clusters trigger schwa insertion/retention, and it is in these /CCC/ contexts that the phonological constraints on the behavior of schwa are most apparent. The discussion will now focus on the identification of these factors.

### 2.3.2. THE SONORITY SEQUENCING PRINCIPLE

*Sonority Sequencing Principle:*  Sonority maxima correspond to sonority peaks.

  The SSP appears to be a major factor in the distribution of schwa. A consonant quite systematically triggers schwa insertion if trapped between two consonants that are less sonorous. I use the sonority scale given in (3) in chapter 1: obstruents (O) < nasals (N) < liquids (L) < glides (G). Recall from section 1.2.2. in chapter 1 that I adopt a sequential version of the SSP, according to which violations only occur when a consonant that is not a permissible sonority peak corresponds to a (local) sonority maximum in the string of segments. In other words, such a consonant triggers a SSP violation if its adjacent segments are all less sonorous. It follows that the SSP can only be violated domain-internally in clusters of three consonants or more, and at domain edges in clusters of two consonants or more. For example, a sequence [VklmV] violates the SSP because [l] is more sonorous than both [k] and [m]; [l] constitutes in this case a local sonority maximum. A word-final [Vkl#] sequence also violates the SSP since [l] is more sonorous than [k], its only neighboring segment. But [VkmlV] obeys the SSP because none of these consonants is a local maximum, sonority increasing from [k] to [l].

  Before we see the effect of the SSP, however, an important digression on the nature of French /r/ is necessary. I consider /r/ to be underlyingly unspecified in manner of articulation. These specifications are established in context, with a major

distinction between prevocalic positions and elsewhere. This includes in particular three contexts: postvocalically (e.g. *partir* 'leave' [partir]), word-finally after an obstruent (e.g. *mettre* 'put' [mɛtr]), and word-initially before a glide /j, ɥ, w/ (e.g. *roi* 'king' [rwa]). Prevocalic /r/ behaves like an obstruent, specified as [-sonorant]; /r/ in the other contexts is more variable but preferably acts like an approximant, more precisely a glide, which I specify as [+vocoid] (see (32) in chapter 1).[35] This is in accordance with Simon (1967), cited in Rialland (1994), who suggests that postvocalic /r/ is a glide.[36] Context-dependent specification of segments is also proposed for the American English /l/ by Espy-Wilson (1992), who consider it to be [+consonantal] prevocalically but [-consonantal] postvocalically.

The phonetic facts (which, however, need to be investigated further) are certainly consistent with this dual nature of /r/. This phoneme is standardly classified as a liquid, but its articulation in French varies between a fricative, a trill, a glide, and even a vowel. Focusing only on the variants articulated in the velar/uvular region, which are those used in modern Parisian French, one can at least distinguish, based on Tranel's (1987b) description, a pharyngeal approximant[37], a uvular trill, a uvular fricative, and a uvular approximant. Lodge (1987), looking at the different realizations of /r/ in a corpus of speakers from Brittany, distinguishes the fricatives [χ, ʁ], the approximant [ʁ], a vocalized [ɤ], and even a null realization Ø. The chosen realization in a given context depends in part on the surrounding segments, but it seems that one major generalization emerges: /r/ tends to be stronger and more consonantal (more fricated) in prevocalic position, and weaker elsewhere (see for example the spectrograms in Rialland 1986).[38] The phonetic

transcriptions for /r/ given in Lodge (1987) are consistent with this characterization: his instances of prevocalic /r/ are all fricatives [χ, ʁ] (e.g. *trembler* 'tremble' [tχãble]; *réduire* 'reduce' [ʁedɥiʁ]), whereas /r/ in other positions varies between fricatives, approximants, vowels, and Ø (50).

(50)    REALIZATIONS OF POSTVOCALIC /r/:
      a. Fricative:       *faire*      'make'       [feʁ]
      b. Approximant:  *réduire*    'reduce'      [ʁedɥiʁ]
      c. Vowel:          *venir*      'come'       [vəniɤ]
      d. Ø                *quatorze*   'fourteen'    [katɔːz]

The low level of consonantality of /r/ in postvocalic position is also supported by a perceptual experiment I have conducted, which involves $C_1VC_2(C_3)$ syllables in which $C_3$ is a stop stripped from its release burst and $C_2$ is any consonant that may appear before a stop word-finally in French [p,k,f,s,m,n,ŋ,l,r] (Côté 2000b). Six French speakers listened to 432 such syllables and had to determine whether $C_3$ was present and, if so, identify it. The results show that $C_3$ is systematically correctly detected and identified when $C_2$ is /r/, but less so when $C_2$ is another consonant. This suggests that postvocalic /r/ behaves more than other consonants like a vocalic element, after which stops are reliably identified. This is consistent with its being a glide in this position.

The variable nature of /r/ explains its behavior with respect to sonority. When it comes to assessing violations of the SSP, /r/ patterns with obstruents prevocalically but otherwise acts like an approximant. The effects of the SSP are most apparent in two contexts: at clitic boundaries and morpheme-internally. Consider clitics first. In (51), we have subject-clitic-verb sequences containing underlying three-consonant clusters in which the middle element is more sonorous than both its flanking consonants. Such sequences violate the SSP and are systematically avoided by the insertion of schwa at the clitic boundary. The schwaless pronunciation is unacceptable. In (52)-(54), I minimally modify the clusters in (51) so as to remove the SSP violations; we observe that schwa insertion is variable in these forms. In (52) and (53), I replace the first and last consonant, respectively, with a more sonorous one. We obtain clusters of decreasing and increasing sonority, respectively, which do not violate the SSP. In contrast with (51), schwa omission is acceptable. In (54) I replace the middle consonant in the clusters in (51) with an obstruent, either /t/ (2nd person sg. object clitic) or /s/ (reflexive clitic). Obstruents being the least sonorous segments, the SSP cannot be violated with obstruents in cluster-medial position. As a result, (54b-c) are unproblematic without schwa. (54a) involves independent factors: the cluster [stʃ] is marginally acceptable because stops are disfavored between two

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[35]The factors that determine the exact realization of /r/ in non-prevocalic contexts are not entirely clear, but the SSP is certainly one of them. In certain contexts, /r/ can be strengthened to an obstruent to avoid SSP violations, in particular phrase-initially and -finally, e.g. *repasser* 'pass again' /r+pase/ → [χpase], *la poutre* 'the beam' /la=putr/ → [laputχ]. I will only be concerned with domain-internal contexts in this section, but a more detailed analysis of the behavior of French /r/ is necessary.

[36]It has also frequently been proposed that American English /r/ is a glide, e.g. by Harris (1994), Reynolds (1994), and Guenter (2000).

[37]This is a non-standard variant; "it is almost always voiced and does not generally include any friction noise" (Tranel 1987b: 142).

[38]I make the hypothesis that this reflects the degree of constriction of /r/: a narrower constriction prevocalically, a wider one in other contexts. This is consistent with the general tendency for consonants to involve a tighter constriction in prevocalic position (see section 3.1.1). The contrast between prevocalic and non-prevocalic articulations, however, appears to be more extreme for liquids than for nasals and obstruents, probably because they are inherently more variable. The frequent vocalization of post-vocalic liquids crosslinguistically reflects this situation. See for instance Espy-Wilson (1992) for a discussion of the acoustic properties of liquids and glides in American English in different contexts, and a comparison between nasals and liquids on pages 745-746.

obstruents (see next section). But it is still better than the cluster [smʃ] in (51a) which violates the SSP. Had I chosen the clitic /s/ instead of /t/, we would have obtained a [ssʃ] cluster, which contains an undesirable sequence of fricatives.

(51)  SCHWA IN /$C_1C_2$=$C_3$/ WHERE $C_2$ IS MORE SONOROUS THAN $C_1$ AND $C_3$:
   a.  *[smʃ]   *Alice me chantait ça*   /alis m=ʃɑ̃tɛ sa/
                'A. sang that to me'     [alismə̩ʃɑ̃tɛsa] *[alismʃɑ̃tɛsa]
   b.  *[plm]   *Philippe le montrait bien*   /filip l=mɔ̃trɛ bjɛ̃/
                'P. showed it well'     [filiplə̩mɔ̃trɛbjɛ̃] *[filiplmɔ̃trɛbjɛ̃]
   c.  *[pmr]   *Philippe me rasait*   /filip m=razɛ/
                'P. shaved me'     [filipmə̩razɛ] *[filipmrazɛ]

(52)  OPTIONAL SCHWA IN /$C_1C_2$=$C_3$/ SEQUENCES OF DECREASING SONORITY:
   a.  [jmʃ]   *Camille me chantait ça*   /kamij m=ʃɑ̃tɛ sa/   [kamij(ə)ʃɑ̃tɛsa]
                'C. sang that to me'
   b.  [rlm]   *Albert le montrait bien*   /albɛr l=mɔ̃trɛ bjɛ̃/   [albɛrl(ə)mɔ̃trɛbjɛ̃]
                'A. showed it well'
   c.  [rmr]   *Albert me rasait*   /albɛr m=razɛ/   [albɛrm(ə)razɛ]
                'A. shaved me'

(53)  OPTIONAL SCHWA IN /$C_1C_2$=$C_3$/ SEQUENCES OF INCREASING SONORITY:
   a.  [smj]   *Alice me jodlait ça*   /alis m=jɔdlɛ sa/   [alism(ə)jodlɛsa]
                'A. yodeled this to me'
   b.  [plw]   *Philippe le ouatait bien*   /filip l=watɛ bjɛ̃/   [filipl(ə)watɛbjɛ̃]
                'P. waded it well'

(54)  OPTIONAL SCHWA IN /$C_1C_2$=$C_3$/ WHERE $C_2$ IS AN OBSTRUENT:
   a.  ?[stʃ]   *Alice te chantait ça*   /alis t=ʃɑ̃tɛ sa/   ?[alistʃɑ̃tɛsa]
                'A. sang that to you'
   b.  [psm]   *Philippe se montrait bien*   /filip s=mɔ̃trɛ bjɛ̃/   [filipsmɔ̃trɛbjɛ̃]
                'P. showed himself well'
   c.  [psr]   *Philippe se rasait*   /filip s=razɛ/   [filipsrazɛ]
                'P. shaved (himself)'

Notice in particular the behavior of /r/. In (51c) it patterns like the cluster-final /ʃ/ in (51a), i.e. as an obstruent. Were the prevocalic [r] in (51c) a liquid, we would predict optional schwa insertion, as in (53), rather than obligatory schwa. The cluster-initial /r/ in (52b-c) is postvocalic and behaves like the approximant /j/ in (52a). Likewise, were the postvocalic /r/ an obstruent in (52b-c), we would expect obligatory schwa insertion, as in (51).

A similar but only partial demonstration can be made with underlying schwas morpheme-initially. In (55a-c) we have adjective-noun sequences which contain an underlying sequence /$C_1C_2$ə$C_3$/ in which $C_2$ is more sonorous than both $C_1$ and $C_3$. To avoid a violation of the SSP, schwa must be retained. In (55d), $C_2$ is /r/, which makes the case a bit more complex. If schwa deletes, /r/ is not prevocalic. Its prefered articulation is then that of a glide, which leads to a violation of the SSP. Schwa is then expected to surface. But the fricative pronunciation of /r/ is not excluded, although it seems to require some emphasis. With a fricative [r] we get a cluster that conforms to the SSP, so the presence of an intervening vowel is not required. This explains that schwa omission seems to be marginally acceptable in this form, unlike those in (55a-c).

(55)  SCHWA IN /$C_1C_2$ə$C_3$/ WHERE $C_2$ IS MORE SONOROUS THAN $C_1$ AND $C_3$:
   a.  *[smz]   *la douce mesure*   /la dus məzyr/
                'the sweet measure'   [ladusmə̩zyr] *[ladusmzyr]
   b.  *[kls]   *à chaque leçon*   /a ʃak ləsɔ̃/
                'at each lesson'   [aʃaklə̩sɔ̃] *[aʃaklsɔ̃]
   c.  *[mls]   *la même leçon*   /la mɛm ləsɔ̃/
                'the same lesson'   [lamɛmlə̩sɔ̃] *[lamɛmlsɔ̃]
   d.  ??[lrp]   *le seul repas*   /lə sœl rəpa/
                'the only meal'   [ləsœlrə̩pa] ??[ləsœlrpa]

We can now try to modify these clusters so as to remove the SSP violations, as we did in (52)-(54). The relevant contrasts are harder to establish with morpheme-internal schwa than at clitic boundaries, however. We can change the initial consonant in (55a-c) to /r/, a more sonorous consonant. We obtain the forms in (56) which are acceptable without schwa.[39] But making the last consonant $C_3$ more sonorous than $C_2$ gives rise to independent problems.[40] We can however change $C_2$ to an obstruent. This automatically makes the cluster conform to the SSP, and schwa can easily be omitted, as shown in (57).

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[39]We cannot do much to the form in (55d) to avoid a violation of the SSP. Since $C_2$=/r/ and /r/ preferably acts like a glide in interconsonantal position, we almost invariably get a SSP violation if schwa deletes, since glides are the most sonorous segments. Only another glide in $C_1$ or $C_3$ would allow us to escape the SSP, but sequences composed of a glide and /r/ are highly disfavored for independent reasons, as we will see in section 2.3.5.2.

[40]We cannot choose /r/, which would behave like an obstruent in this position. Glides are not found as the post-schwa consonant in words of the form /CəC.../. We are left with /l/ instead of /z/ in (55a) but we obtain a nasal+lateral sequence which is also independently disfavored.

(56)  OPTIONAL SCHWA IN /$C_1C_2$ə$C_3$/ SEQUENCES OF DECREASING SONORITY:
  a.  ?[rmz]  *la dernière mesure*        /la dɛrnjɛr məzyr/
              'the last measure'          [ladɛrnjɛrmə̠zyr] ?[ladɛrnjɛrmzyr]
  b.  [rls]   *la pire leçon*             /la pir ləsɔ̃/
              'the worst lesson'          [lapirl(ə̠)sɔ̃]

(57)  OPTIONAL SCHWA IN /$C_1C_2$ə$C_3$/ WHERE $C_2$ IS AN OBSTRUENT:
  a.  [spl]   *la douce pelouse*          /la dus pəluz/
              'the sweet lawn'            [ladusp(ə̠)luz]
  b.  [ksm]   *à chaque semaine*          /a ʃak səmɛn/
              'at each week'              [aʃaks(ə̠)mɛn]

Let us now look at the contexts other than at clitic boundaries and morpheme-internally. Two of them are immune to the effect of the SSP. At derivational suffix boundaries, three-consonant sequences are never observed on the surface, since schwa insertion is automatic when such sequences arise underlyingly. The SSP is therefore irrelevant in this context, given that it can only be violated domain-medially in sequences of at least three consonants. As for forms involving the 1st/2nd plural conditional endings /-rjɔ̃, rje/, they never violate the SSP because /r/ is not more sonorous than /j/.

We are left with two contexts: before future and conditional endings other than /-rjɔ̃, rje/ and at word boundaries. In both of them the SSP plays an active role in eliminating schwaless outputs that violate it. The sequences that violate the SSP are all of the form $C_1C_2$-$C_3$, where $C_1C_2$ is a morpheme- or word-final cluster in which $C_2$ is more sonorous than $C_1$. Clusters of this form are composed of obstruent+/m/, obstruent+/l/, and obstruent+/r/ sequences.

In the future/conditional endings /-rV/, the prevocalic /r/ behaves like an obstruent. When these suffixes attach to stems ending in a obstruent+sonorant clusters, the SSP is violated because the middle sononant is surrounded by two less sonorous obstruents. Schwa insertion is therefore obligatory (58).

(58)  OBLIGATORY SCHWA BEFORE FUTURE AND CONDITIONAL ENDINGS WITH OBSTRUENT+SONORANT STEMS:
  a.  *[blr]   *doublerai*                /dubl+re/
              'double+FUT.1SG'            [dublə̠re] *[dublre]
  b.  *[smr]   *fantasmerai*              /fɑ̃tasm+re/
              'have fantasies+FUT.1SG'    [fɑ̃tasmə̠re] *[fɑ̃tasmre]

At word boundaries, we have to look separately at obstruent+/m/ and obstruent+/l, r/ clusters. O+/m/+C sequences behave as expected. When the final consonant is less sonorous than /m/ (i.e. when it is an obstruent), the SSP is violated and it is only marginally acceptable to omit the schwa at the boundary (59). We can change the word following the boundary so that its initial consonant will be less sonorous than /m/. We obtain the clusters like /sm-l/ in (60a) and /tm-j/ in (60b). The SSP is respected and schwa can be more freely omitted in these phrases.

(59)  SCHWA IN /ON-O/ CLUSTERS AT WORD BOUNDARIES:
  a.  ??[smp]  *le tourisme parisien*     /l=turism parizjɛ̃/
              'the Parisian tourism'      [ləturismə̠parizjɛ̃] ??[ləturismparizjɛ̃]
  b.  ??[tmk]  *le rythme colombien*      /l=ritm kɔlɔ̃bjɛ̃/
              'the Colombian rhythm'      [ləritmə̠kɔlɔ̃bjɛ̃] ??[ləritmkɔlɔ̃bjɛ̃]

(60)  SCHWA IN /ON-L/ AND /ON-G/ CLUSTERS AT WORD BOUNDARIES:
  a.  [sml]    *le tourisme libanais*     /l=turism libanɛ/
              'the Lebanese tourism'      [ləturism(ə̠)libanɛ]
  b.  [tmj]    *le rythme yougoslave*     /l=ritm jugɔslav/
              'the Yugoslav rhythm'       [ləritm(ə̠)jugɔslav]

With word-final O+/l,r/ clusters, the situation is less clear. In a /Or-C/ or /Ol-C/ cluster, the SSP is violated when the final C is less sonorous than /r/ or /l/. A couple of relevant examples are given in (61)[41]; the marginality of the schwaless output parallels that observed in (59). Now, if we replace the cluster-final consonant with a glide, we eliminate the SSP violation and expect schwa to be omitable. This prediction is only partially borne out. The examples in (62) are better than those in (61) but not as good as those in (60). Their marginality is probably to be attributed to an independent constraint against consonant+liquid+glide sequences. See section 2.3.5.2.

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[41] About the forms in (61), I have to mention that there is some uncertainty in the literature over whether schwa is obligatory in OL-C contexts at word boundaries. At least since Dell (1973/1980/1985), it is standard to consider that it is, but several authors claim otherwise: Bazylko (1981) contrasts *autrefois* 'formerly' [otrə̠fwa] and *autre fois* 'other time' [otrfwa], Zwanenburg (1968) opposes *humblement* 'humbly' [œ̃blə̠mɑ̃] and *humble mentalité* 'humble mentality' [œ̃blmɑ̃talite]. See also Grammont (1894: 76), Fouché (1959: 96), Malmberg (1975: 76). Corpus studies (Laks 1977; Chevrot, Beaud & Varga, to appear; Chevrot & Côté, in progress) also provide several examples of OL sequences in pre-consonantal position, without schwa insertion. I therefore take schwa to be marginally possible, although it is normally present (and possibly obligatory for some speakers). The strength of the prosodic boundary in the OL-C sequence certainly plays a role, the weaker the boundary, the more likely it is that schwa be inserted. More on the effect of the prosodic boundary in section 2.3.6.

(61)  SCHWA IN /OL-O/ AND /OL-N/ CLUSTERS AT WORD BOUNDARIES:
      a.  ??[klp]    *mon oncle paternel*           /mɔ̃=ɔ̃kl patɛrnɛl/
                     'my paternal uncle'            [mɔ̃nɔ̃klə̲patɛrnɛl] ??[mɔ̃nɔ̃klpatɛrnɛl]
      b.  ??[trm]    *les quatre musées*            /lɛ=katr myze/
                     'the four museums'             [lɛkatrə̲myze] ??[lɛkatrmyze]

(62)  SCHWA IN /OL-G/ CLUSTERS AT WORD BOUNDARIES:
      a.  ?[klj]     *mon oncle yougoslave*         /mɔ̃=ɔ̃kl jugɔslav/
                     'my Yugoslav uncle'            [mɔ̃nɔ̃klə̲jugɔslav] ?[mɔ̃nɔ̃kljugɔslav]
      b.  ?[trɥ]     *les quatre huissiers*         /lɛ=katr ɥisje/
                     'the four ushers'              [lɛkatrə̲ɥisje] ?[lɛkatrɥisje]

I have shown in this section that the SSP is an inviolable constraint in French, except marginally at word boundaries. It motivates the insertion or retention of schwa in contexts where its omission would yield a violation of this principle. Crucial to this conclusion is our analysis of /r/ as a fricative in prevocalic position but normally an approximant in other segmental contexts, notably postvocalically.

**2.3.3. THE SPECIAL STATUS OF STOPS**

*Generalization 2:*    Stops want to be adjacent to a vowel, and preferably followed by a vowel.

As in all the deletion patterns described in the preceding chapter, stops must be distinguished from other consonants in that they show a greater propensity to trigger schwa insertion or block schwa deletion when they find themselves trapped between two consonants. This tendency, already mentioned in Grammont (1894) and Leray (1930), can be illustrated at clitic and word boundaries as well as morpheme-internally. A full comparison can only be made with fricatives, mainly because interconsonantal sonorants are disfavored or banned in this position for independent reasons, mainly the SSP, but also constraints against sequences of certain sonorant combinations, which will be discussed below.

Compare the data in (63) and (64). They all consist in an underlying sequence /...VC##CəCV.../, with a prenominal modifier ending in a consonant followed by a noun with an underlying schwa in its first syllable. Deletion of the schwa generates a sequence of three consonants. The clusters in (63) and (64) differ only in the identity of the medial consonant: a stop in (63), a fricative in (64). Whether the preceding consonant is a lateral (c), a nasal (b), or an obstruent (a), deleting the underlying

schwa is a marked option when the medial consonant is a stop (63), but yields quite natural outputs with fricatives (64).

(63)  OBLIGATORY SCHWA IN /$C_1C_2əC_3$/ WHERE $C_2$ IS A STOP:
      a.  *[sdm]    *la douce demie*           /la=dus dəmi/
                    'the sweet half'           [ladusdə̲mi] *[ladusdmi]
      b.  *[mdm]    *la même demande*          /la=mɛm dəmãd/
                    'the same request'         [lamɛmdə̲mãd] *[lamɛmdmãd]
      c.  *[ldm]    *la seule demeure*         /la=sœl dəmœr/
                    'the only residence'       [lasœldə̲mœr] *[lasœldmœr]

(64)  OPTIONAL SCHWA IN /$C_1C_2əC_3$/ WHERE $C_2$ IS A FRICATIVE:
      a.  [tsm]     *dix-sept semaines*        /dis(s)ɛt səmɛn/     [dis(s)ɛts(ə)mɛn]
                    'seventeen weeks'
      b.  [mʃm]     *la même chemise*          /la=mɛm ʃəmiz/       [lamɛmʃ(ə)miz]
                    'the same shirt'
      c.  [lfn]     *la seule fenêtre*         /la=sœl fənɛtr/      [lasœlf(ə)nɛtr]
                    'the only window'

The same contrast can be observed at clitic boundaries. The examples in (65) and (66) consist in a subject+object clitic+verb sequence containing an underlying three-consonant cluster. Again, these clusters contrast only on whether the middle consonant is a stop (65) or a fricative (66). Unlike the examples in (63) with underlying schwas, those involving a stop at a clitic boundary are not unacceptable, but certainly marginal; the contrast with the clusters with fricatives in (66) is clear, as these are perfectly natural without schwa.

(65)  SCHWA MORE LIKELY IN /$C_1C_2=C_3$/ WHERE $C_2$ IS A STOP:
      a.  ?[stm]    *Alice te mentait*     /alis t=mãtɛ/     [alistə̲mãtɛ]     ?[alistmãtɛ]
                    'A. lied to you'
      b.  ?[ntm]    *Aline te mentait*     /alin t=mãtɛ/     [alintə̲mãtɛ]     ?[alintmãtɛ]
                    'A. lied to you'
      c.  ?[ltm]    *Emile te mentait*     /emil t=mãtɛ/     [emiltə̲mãtɛ]     ?[emiltmãtɛ]
                    'E. lied to you'

(66)  SCHWA LESS LIKELY IN /$C_1C_2=C_3$/ WHERE $C_2$ IS A FRICATIVE:
      a.  [tsm]     *Annette se mentait*   /anɛt s=mãtɛ/     [anɛts(ə)mãtɛ]
                    'A. lied to herself'
      b.  [nsm]     *Aline se mentait*     /alin s=mãtɛ/     [alins(ə)mãtɛ]
                    'A. lied to herself'

c. [lsm]　*Emile se mentait*　　/emil s=mãtɛ/　[emils(ə)mãtɛ]
　　　　　'E. lied to himself'

At word boundaries, schwa is never obligatory and less likely in any segmental context than at other boundaries. The contrast between stops and fricatives is less apparent but can probably be observed in the relative frequency of schwa in contexts $/C_1C_2$-$C_3/$ where $C_2$ is a stop vs. a fricative. For example, the intuition is undoubtedly that schwa is more likely to appear in *casque noir* 'black helmet' /kask nwar/ than in *taxe noire* 'black tax' /taks nwar/.

Interestingly, the conjunction of the SSP, the greater resistance of stops to surface between consonants and the tendency to avoid sequences of sonorant consonants (see below) results in fricatives having a privileged status in cluster-medial position, and generally in positions with no adjacent vowels. In a $C_1C_2C_3$ sequence, only with fricatives in $C_2$ will the sequence necessarily escape major constraints. Stops are disfavored in this position because they want, more than other consonants, to appear next to a vowel; sonorants are banned if surrounded by less sonorous consonants because this would violate the SSP; in addition, as we will see below, certain sequences of sonorant consonants tend to be avoided. In contrast, having fricatives in $C_2$ cannot result in a violation of the SSP nor in undesirable sonorant clusters.[42]

The marked preference for fricatives within clusters has been noticed several times in the context of the behavior of schwa, especially by phoneticians (Grammont 1894, 1914/1961; Leray 1930; Fouché 1959; Rialland 1986). Malécot (1976: 99) confirms this tendency in his statistical analysis of a corpus of natural speech. He counted the percentage of schwa omission in clitics in utterance-initial position, that is in the context $/C_1=C^nV.../$. He obtained the numbers in (67). When the clitic corresponds to a fricative, schwa was not pronounced approximately half of the time, e.g. in *je vais* 'I go' /ʒ=vɛ/. By contrast stops and liquids in $C_1$ triggered schwa insertion quite systematically, e.g. *que ça* 'only that' /k=sa/ or *le bus* 'the bus' /l=bys/. The first example involves a stop that precedes another obstruent, the second one violates the SSP. This demonstrates that fricatives are much more easily tolerated than other consonants in contexts where there are no adjacent vowels.

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[42]I believe this explanation for the special status of fricatives in the distribution of schwa carries over to their privileged position cross-linguistically at word edges and cluster-internally. It applies most particularly to strident fricatives, which carry the strongest internal cues.

(67)　PERCENTAGE OF SCHWA OMISSION IN $/C_1=C^nV/$ UTTERANCE-INITIALLY:
　　　a. $C_1$ is a stop:　　　　4%
　　　b. $C_1$ is a fricative:　　44%
　　　c. $C_1$ is a liquid:　　　0%　　　　　　　　　　(Malécot 1976)

### 2.3.4. STOPS FOLLOWED BY A [-CONTINUANT] SEGMENT

*Generalization 3*:　　Stops that are not followed by a [+continuant] segment want to be adjacent to a vowel, and preferably followed by a vowel.

The continuancy value of the following segment is crucial in cluster simplification in Hungarian (section 1.2.3.1): stops delete only if followed by a [-continuant] consonant. We could expect the distribution of schwa to also be sensitive to the identity of the segment following a cluster-medial stop. The effect of this factor seems to be overall rather limited, but is clearly detected in at least one context, morpheme-internally. Consider words that start with the sequence $/C_1əC_2.../$, in which $C_1$ is a stop. When these words appear in post-consonantal position, the schwa in the initial syllable is more likely to be dropped if $C_2$ is [+continuant] than if it is [-continuant]. This is illustrated by the examples in (68) and (69), where the a. and b. examples contrast in the nature of $C_2$: a labial nasal in (68a, 69a) vs. a labial fricative in (68b, 69b). In (68) we have suject+verb sequences, in (69) adjective+noun ones (see Lyche & Durand 1996 for similar examples). Schwa more easily deletes in the first structure, but we observe in both cases a clear contrast: schwa is more readily omitted if this results in a stop being followed by a [+continuant] rather than a [-continuant] segment.

(68)　SCHWA IN SUBJECT+VERB $/C##C_1əC_2/$ SEQUENCES WHERE $C_1$ IS A STOP:
　　　a. *Aline demeure ici*　　　/alin dəmœr isi/　　??[alindmœrisi]
　　　　　'A. lives here'
　　　b. *Aline devait y aller*　　/alin dəvɛ i=ale/　　[alindvɛjale]
　　　　　'A. had to go there'

(69)　SCHWA IN ADJ+NOUN $/C##C_1əC_2/$ SEQUENCES WHERE $C_1$ IS A STOP:
　　　a. *les mêmes demandes*　　/lɛ=mɛm dəmãd/　*[lɛmɛmdmãd]
　　　　　'the same requests'
　　　b. *les mêmes devinettes*　/lɛ=mɛm dəvinɛt/　?[lɛmɛmdvinɛt]
　　　　　'the same riddles'

**2.3.5. SIMILARITY TO ADJACENT CONSONANTS**

*Generalization 4*:     Consonants that are relatively similar to a neighboring segment want to be adjacent to a vowel, and preferably followed by a vowel.

The distribution of schwa is affected by contrast between adjacent consonants. In a $C_1C_2C_3$ sequence, the presence of shared features between $C_2$ and its neighboring segments favors schwa insertion/retention. Alternatively, the presence of a contrast between a consonant and its adjacent segment facilitates its surfacing in interconsonantal position, without the need for schwa epenthesis to provide it with an adjacent vowel. The process is most sensitive to contrast/similarity in manner of articulation, while place seems to play a marginal role, which I will not discuss.

Recall from the discussion of Hungarian that I adopt Clements's (1990) major class features to classify consonants: [sonorant], [approximant], [vocoid]. We obtain the following feature specifications for the different classes of consonants. In a complete system we need an additional feature to distinguish between stops and fricatives; I briefly discuss this issue in chapter 4. Recall that non-prevocalic /r/ is considered a glide and is by definition [+vocoid].

(70)     CLEMENTS'S (1990) MAJOR CLASS FEATURES:

|             | Obstruents | Nasals | Liquids | Glides |
|-------------|------------|--------|---------|--------|
| Sonorant    | –          | +      | +       | +      |
| Approximant | –          | –      | +       | +      |
| Vocoid      | –          | –      | –       | +      |

It appears that the major part of the work is accomplished by the feature [vocoid]. On the one hand, the presence of a contrast in this feature clearly facilitates the omission of schwa. On the other hand, sequences of [+vocoid] consonants ([r] and glides) are disfavored. Other features are also active, but their effect is more subtle and limited than that of the feature [vocoid]. A tendency to avoid sequences of [+approximant] consonants, for instance, can be detected. This crucially concerns sequences of [l]+glides (as clusters containing [r] and glides are already covered by the constraint against [+vocoid] segments). I discuss first the effect of a contrast in [vocoid], then that of sequences of [+vocoid] consonants, with an extension to [+approximant].

**2.3.5.1. Contrast in [vocoid]**

Numerous authors have noticed the special status of /r/ in the distribution of schwa. In all contexts consonants are more easily tolerated in interconsonantal position if the preceding consonant is /r/ than if it is a lateral, a nasal, or an obstruent (Delattre 1951; Dauses 1973; Dell 1973/1980/1985, 1977; Domingue 1974; Morin 1974; Tranel 1987b; Spa 1988; van Eibergen 1992). This special status should be extended to include at least the glide [j]; the other glides [w, ɥ] are not found in the relevant position. I suggest, then, that the correct generalization is that a consonant is less likely to trigger schwa insertion/retention if it contrasts in the feature [vocoid] with the preceding segment. This is expressed below:

(71)     CONTRAST IN [VOCOID] AND THE BEHAVIOR OF SCHWA:
A consonant that contrasts in the feature [vocoid] with the preceding segment is less likely to trigger schwa epenthesis/retention.

This effect is best illustrated with a stop in cluster-medial position (since fricatives are freely allowed in this position and sonorants subject to independent constraints; see section 2.3.3). The data in (72) show that schwa is optional when a stop at a clitic boundary is preceded by a glide, /j/ or /r/. These examples contrast with those given in (65) and repeated below, where the stop is preceded by a different consonant, the rest of the context being identical.

(72)     STOPS PRECEDED BY A GLIDE AT CLITIC BOUNDARIES:
a.  [jtm]     *Camille te mentait*     /kamij t=mɑ̃tɛ/        [kamijt(ə)mɑ̃tɛ]
               'C. lied to you'
b.  [rtm]     *Albert te mentait*      /albɛr t=mɑ̃tɛ/       [albɛrt(ə)mɑ̃tɛ]
               'A. lied to you'

(65)     STOPS PRECEDED BY A NON-GLIDE AT CLITIC BOUNDARIES:
a.  ?[stm]    *Alice te mentait*       /alis t=mɑ̃tɛ/    [alistəmɑ̃tɛ]     ?[alistmɑ̃tɛ]
               'A. lied to you'
b.  ?[ntm]    *Aline te mentait*       /alin t=mɑ̃tɛ/    [alintəmɑ̃tɛ]     ?[alintmɑ̃tɛ]
               'A. lied to you'
c.  ?[ltm]    *Emile te mentait*       /emil t=mɑ̃tɛ/    [emiltəmɑ̃tɛ]     ?[emiltmɑ̃tɛ]
               'E. lied to you'

The same opposition is found with underlying schwas in word-initial syllables. The data in (63) above and repeated here showed that in the context /…VC$_1$##C$_2$əC$_3$V…/, schwa is obligatorily retained if C$_2$ is a stop preceded by a

consonant and followed by a [-continuant] segment. If $C_1$ is a glide, however, schwa omission becomes clearly more acceptable (73).

(73)    STOPS PRECEDED BY A GLIDE IN /$C_1C_2$ə$C_3$/:
   a.    ?[rdm]    *la pire demie*    /la=pir dəmi/    [lapirdə̠mi] ?[lapirdmi]
                   'the worst half'
   b.    [rdm]     *pour demander*    /pur dəmãde/    [purd(ə̠)mãde]
                   'to request'

(63)    STOPS PRECEDED BY A NON-GLIDE IN IN /$C_1C_2$ə$C_3$/:
   a.    *[sdm]    *la douce demie*    /la=dus dəmi/
                   'the sweet half'      [ladusdə̠mi] *[ladusdmi]
   b.    *[mdm]    *la même demande*    /la=mɛm dəmãd/
                   'the same request'    [lamɛmdə̠mãd] *[lamɛmdmãd]
   c.    *[ldm]    *la seule demeure*    /la=sœl dəmœr/
                   'the only residence'  [lasœldə̠mœr] *[lasœldmœr]

As is usually the case, the point is more difficult to illustrate at word boundaries, because schwa can be more freely omitted in this position than in any other. Yet one can feel that schwa is less likely to be inserted in the context /$C_1C_2$##$C_3$/ if $C_1$ is a glide. Compare the two examples in (74) which differ in the quality of $C_1$: a glide in (74a) vs. a fricative in (74b). Schwa can be considered optional in both cases but the intuition is that it is more likely to appear in (74b).

(74)    STOPS PRECEDED BY A CONSONANT AT WORD BOUNDARIES
   a.    [rdm]    *le garde mentait*    /l=gard mãtɛ/    [ləgard(ə̠)mãtɛ]
                  'the guard lied'
   b.    [skm]    *le masque mentait*    /l=mask mãtɛ/    [ləmask(ə̠)mãtɛ]
                  'the mask lied'

This intuition is supported by a study conducted by Dell (1977). Dell constructed a series of sentences containing sequences of the type /...$C_1C_2$##$C_3$.../, with different combinations of $C_1$ and $C_2$ and in three different syntactic structures: adjective+noun (ex. *modeste vendeur* 'modest seller'), noun+adjective (ex. *cordes volées* 'stolen ropes'), and subject+verb, as in (74). In all the sentences $C_3$=/v/. These sentences were presented to 11 speakers, in a test designed so that the relevant portion of the sentences was uttered 3 times by each speaker. The percentage of utterances in which schwa was present was calculated for each segmental and syntactic context. The results are clear: in each syntactic context, schwa is more often omitted if $C_1$ is a glide than if it is an obstruent, with $C_2$ being a stop. The relevant

statistics are provided below: each number indicates the percentage of utterances in which schwa was pronounced, for a given syntactic context and combination of $C_1$ and $C_2$. The numbers are significantly higher for all the obstruent+stop combinations in (75a) than the /r/+stop ones in (75b), in the same syntactic context. The differences observed among the syntactic contexts will be discussed in section 2.3.6.

(75)    FREQUENCY OF SCHWA IN VARIOUS SYNTACTIC AND SEGMENTAL CONTEXTS (Dell 1977):

| $C_1C_2$ | Adj+Noun | Noun+Adj | Subj+Verb |
|---|---|---|---|
| a.  sk | 81 | 60 | 15 |
| kt | 78 | 60 | 12 |
| st | 78 | 18 | 6 |
| b.  rd | 30 | 21 | 0 |
| rt | 42 | 3 | 0 |
| rb | 30 | 12 | 0 |

### 2.3.5.2. Agreement in [+vocoid]

The preceding section has shown that a consonant that contrasts in the feature [vocoid] with the preceding segment can more easily surface in interconsonantal position without the support of an epenthetic schwa. This section is devoted to the opposite situation, when a consonant shares the same value for this feature with a neighboring segment, specifically the positive value. Two adjacent segments that share the specification [+vocoid] are relatively similar and want more than other consonants to surface next to a vowel. Agreement in [+vocoid] then favors schwa epenthesis. This is expressed in (76), which follows from the generalization 4 given at the outset of this section.

(76)    AGREEMENT IN [+VOCOID] AND THE BEHAVIOR OF SCHWA:
        A consonant that agrees in the feature [+vocoid] with a neighboring segment wants to be adjacent to a vowel and is therefore more likely to trigger schwa epenthesis/retention.

This explains the behavior of schwa with the 1st/2nd plural conditional endings /-rjɔ̃, -rje/. As already noticed several times, schwa insertion is obligatory in this context with consonant-final verbal stems. The representative examples in (27) are repeated below.

(27)  SCHWA OBLIGATORY BEFORE 1ST/2ND PLURAL CONDITIONAL ENDINGS:
    a.  *gâterions*     'spoil+COND.1PL'    /gat+rjɔ̃/    [gatə̠rjɔ̃]
    b.  *fumeriez*     'smoke+COND.2PL'    /fym+rje/    [fymə̠rje]
    c.  *garderiez*     'keep+COND.2PL'    /gard+rje/    [gardə̠rje]

The /r/ of the suffix is not prevocalic and is specified as [+vocoid]. So is the glide /j/. Both consonants agree in [+vocoid] and therefore need to be adjacent to a vowel. /j/ necessarily meets this condition since it is followed by /e/ or /ɔ̃/, but /r/ is the potentially offending segment. When the suffix comes after a consonant-final stem, /r/ is trapped between two consonants. Schwa is then inserted to meet the requirement that a consonant that agrees in [+vocoid] with an adjacent segment surfaces next to a vowel, following (76).

The constraint in (76) is also active at word boundaries, although in this context agreement in [+vocoid] only triggers schwa insertion optionally. The relevant context arises when a word beginning in a /r/+glide sequence follows one ending in a consonant. Examples were given in (36), repeated below. No other word-initial cluster is as likely to trigger epenthesis at word boundaries.

(36)  OPTIONAL SCHWA WORD-INITIALLY BEFORE /r/+GLIDE SEQUENCES:
    a.  *aime rien*     'like nothing'    /ɛm rjɛ̃/    [ɛm(ə)rjɛ̃]
    b.  *Patrick Roy*    (name)    /patrik rwa/    [patrik(ə)rwa]

Historically, it seems that the constraint in (76) was more general and applied to sequences of consonants that agreed in the feature [+approximant] rather than [+vocoid]. That is, it targeted not only glides but also liquids, namely /l/.[43] So not only were sequences C+/r/+glide actively avoided by schwa insertion/retention, as in contemporary French, but also sequences C+/l/+glide. The constraint against such clusters prevented schwa deletion morpheme-internally in words like *Richelieu* (proper name) [riʃəljø] *[riʃljø]. Since these internal schwas have stabilized and are obligatorily pronounced in modern French, I assume that they have been reanalyzed as stable vowels: /riʃœljø/. This constraint is also the source of now morphologized alternations between [œ] and Ø in derivational paradigms (see note 4). For example, the word *bourrelet* 'pad, horse-collar' [burlɛ], in which no vowel is pronounced between [r] and [l], contrasts with the related word *bourrelier* 'harness-maker' [burœlje] *[burlje], with a stable [œ] which is the contemporary reflex of a historic schwa that did not delete to prevent a violation of the constraint against C+/l/+glide sequences.

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[43]Historically it may be that /r/ was specified [+approximant, -vocoid], like /l/ and unlike the non-prevocalic modern /r/.

Such sequences are no longer synchronically actively avoided. In contrast with the examples in (36), words that start with a sequence /l/+glide (/lw-, lj-, lɥ/, e.g. *lieu* 'location' /ljø/, *loi* 'law' /lwa/, *lui* 'him' /lɥi/) do not normally trigger schwa insertion when preceded by a consonant, as shown in (77).

(77)  NO SCHWA WORD-INITIALLY BEFORE /l/+GLIDE SEQUENCES:
    a.  *donne-lui*     'give him'    /dɔn lɥi/    [dɔnlɥi]
    b.  *grande loi*    'great law'    /grɑ̃d lwa/    [grɑ̃dlwa]

There is no suffix that starts with the sequence /l/+glide, so no direct comparison can be made with the data in (27). But C+/l/+glide sequences arise in 1st/2nd plural imperfect or subjunctive forms of verbs with a stem ending in an /-rl/ sequence, e.g. *parliez* 'speak+IMP/SUBJ.2PL' /parl+je/ [parlje]. Such forms freely surface with a C+/l/+glide sequence, which is not repaired by schwa insertion or glide vocalization, as the 1st/2nd plural conditional forms in (27) (see note 13 on glide vocalization in these forms).

Segments that agree in [+approximant] but not in [+vocoid] (e.g. /l/ and glides) are necessarily less similar than segments that share the specification [+vocoid] (e.g. /r/ and glides). Consonants that only agree in [+approximant] should therefore be less susceptible to triggering schwa epenthesis than consonants that agree in [+vocoid]. The historical development, which restricted the sequences to be avoided to C+/r/+glide corresponds to a move toward less strict requirements over the minimum amount of contrast that is desired in sequences of consonants. The relative undesirability of C+/l/+glide clusters may still however have a marginal effect in /...$C_1C_2$-$C_3$.../ contexts, where the boundary is a clitic or a word one. In the discussion on the role of the SSP, I provided the data in (60b) and (62a), repeated below. The underlying clusters contained in these nominal phrases crucially differ on whether the medial consonant is a nasal (60b) or a lateral (62a). Neither of these clusters violates the SSP; yet schwa insertion is more clearly prefered over its omission in the second example than in the first one. This contrast could result from the remote effect of a constraint against C+/l/+glide sequences, which is irrelevant in (60b). A similar contrast can be observed at clitic boundaries, between (53a) and (78).

/$C_1C_2$-$C_3$/ AT WORD BOUNDARIES WITH $C_3$=GLIDE AND $C_2$=/l/ VS. NASAL:

(60)  b.  [tmj]    *le rythme yougoslave*    /l=ritm jugɔslav/
                    'the Yugoslav rhythm'    [lə̠ritm(ə)jugɔslav]
(62)  a.  ?[klj]    *mon oncle yougoslave*    /mɔ̃=ɔ̃kl jugɔslav/
                    'my Yugoslav uncle'    [mɔ̃nɔ̃klə̠jugɔslav] ?[mɔ̃nɔ̃kljugɔslav]

/C₁C₂=C₃/ AT CLITIC BOUNDARIES WITH C₃=GLIDE AND C₂=/l/ VS. NASAL:

(53)   a.   [smj]   *Alice me jodlait ça*        /alis m=jɔdlɛ sa/
                    'A. yodeled this to me'      [alism(ə)jodlɛsa]
(78)          ?[slj]   *Alice le jodlait bien*        /alis l=jɔdlɛ bjɛ̃/
                    'A. yodeled it well'         [alislə̱jodlɛbjɛ̃]  ?[alisljodlɛbjɛ̃]

### 2.3.6. PROSODIC BOUNDARIES

| *Generalization 5:* | Consonants that are not at the edge of a prosodic domain want to be adjacent to a vowel, and preferably followed by a vowel. |
|---|---|

The distribution of schwa is sensitive to the strength of the prosodic boundary, if any, that is adjacent to the consonants that lack a flanking vowel. The higher the prosodic boundary, the more easily a consonant may survive without an adjacent vowel, the less likely schwa epenthesis/retention is. The prosodic hierarchy I adopt goes from the Prosodic Word (PW) up to the Utterance (U). I assume that constituents below the PW level belong to a separate hierarchy (Selkirk 1986; Zec 1988; Inkelas 1989). Intermediate levels between the PW and the U include the Phonological Phrase (PP) and the Intonational Phrase (IP) (e.g. Inkelas & Zec 1995). For French, I follow Selkirk (1986) and de Jong (1990, 1994), who have proposed that the PP is split between a Small and a Maximal Phonological Phrase (SPP, MPP). This is summarized in (79).

(79)   PROSODIC HIERARCHY:
                    U
                    |
                    IP
                    |
                    MPP
                    |
                    SPP
                    |
                    PW

We have already seen several illustrations of the effect of the prosodic structure on the behavior of schwa, although I have not focused on this aspect of the data so far. First, the same sequence of consonants may obligatorily trigger schwa insertion word-internally but it may be tolerated across a PW boundary. In other words, a consonant in the same segmental context may be allowed to surface without an adjacent vowel only when preceded or followed by a PW boundary. The

two pairs of examples in (80) contain the same underlying sequences [stm] and [rdr]. In the first example, the middle consonant [t] or [d] is followed by a word-internal suffix and is not adjacent to any relevant prosodic boundary. Schwa insertion is obligatory. In the second example, the stop is followed by a PW boundary and in both cases schwa omission becomes possible (but not obligatory).

(80)   EFFECT OF A FOLLOWING PW BOUNDARY ON THE BEHAVIOR OF SCHWA:
       a.   [stm]   *justement*     'justly'            /ʒyst+mã/        [ʒystə̱mã]
                    *le juste ment*   'the just lies'     /l=ʒyst mã/      [ləʒyst(ə)]_PW mã]
       b.   [rdr]   *la garderie*   'the kindergarden'  /la=gard+ri/     [lagardə̱ri]
                    *le garde rit*    'the guard laughs'  /l=gard ri/      [ləgard(ə)]_PW ri]

Likewise, we have just seen in the preceding section that C+/r/+glide sequences are banned across a PW-internal morpheme boundary (27b) but permitted in the phrasal domain (36a). That is, a consonant that agrees in the feature [+vocoid] with an adjacent segment requires a flanking vowel when no prosodic boundary is present, but not when it is preceded by a PW boundary. This contrast is illustrated below with the sequence [mrj] in a 2nd plural conditional form (81a) and verb+object sequence (81b).

(81)   EFFECT OF A PRECEDING PW BOUNDARY ON THE BEHAVIOR OF SCHWA:
       b.   *aimeriez*     'like+COND.2PL'   /ɛm+rje/       [ɛmə̱rje]
       a.   *aime rien*    'like nothing'    /ɛm rjɛ̃/       [ɛm _PW[(ə)rjɛ̃]

The phrase-initial position has also been presented as a privileged one for the licensing of consonants. See the data in (24) and the discussion of phrase-initial extrasyllabicity in section 2.2.2.2. In (82) I provide an illustration of the phrase-initial effect with an underlying sequence /Vn##dəmV.../. In (82a) the [d] is preceded by a PW boundary and schwa retention is obligatory. In (82b) a stronger boundary separates the [n] from the following [d], which may now surface without the support of its lexical schwa. It has not been made clear what phrasal level (SPP, MPP, IP, U) is endowed with additional licensing possibilities; as we will see below, the effects are cumulative, from the PW to the U, but I use an IP boundary in (82b), which is a likely one in this dislocation context.

(82)   EFFECT OF A PRECEDING IP VS. PW BOUNDARY ON THE BEHAVIOR OF SCHWA:
       a.   *une demande*      'a request'       /yn dəmãd/      [yn _PW[də̱mãd]
       b.   *Anne, demande-la*   'A., ask for it'  /an dəmãd la/   [an _IP[d(ə)mãdla]

The three cases just presented involve a two-way contrast between internal and peripheral positions of some prosodic domain. This appears to be a simplification or an idealization of the facts. The effects of the prosodic structure are rather cumulative: the stronger the adjacent boundary, the more easily a consonant may surface without the support of an adjacent vowel. The cumulativity of edge effects is probably the most interesting result of Dell's (1977) study on the frequency of schwa insertion in different segmental and syntactic contexts, cited in section 2.3.5.1.

Recall that Dell (1977) compares the frequency of schwa insertion in adjective+noun, noun+adjective, and subject+verb sequences of the form $/...C_1C_2\#\#C_3.../$. He found that, for any given cluster, vowel insertion is most frequent in adjective+noun sequences, less frequent in noun+adjective ones, and least likely in subject+verb structures. Percentages for a subset of the clusters tested were provided in (75). These results can be directly transposed in prosodic terms, using elements of the prosodic structure of French proposed by Selkirk (1986) and de Jong (1990, 1994). Adjective+noun sequences form a SPP, the adjective being followed only by a PW boundary: adj ]$_{PW}$ noun. Noun+adjective sequences form a MPP, the noun being followed by a SPP boundary: noun ]$_{SPP}$ adj. Subjects are separated from the predicate by at least a MPP boundary: subj ]$_{MPP}$ verb. What we have is a $C_1C_2]C_3$ sequence with $C_2$ being followed by an increasingly stronger prosodic boundary. Schwa omission is optional in all these cases, but its likelihood correlates with the strength of the adjacent boundary.

This generalization extends to both lower and higher prosodic boundaries. If $C_2$ is followed by no (relevant) prosodic boundary, e.g. at a word-internal morpheme juncture, schwa epenthesis is more likely than in adj+noun sequences; it is even often obligatory. At the other end of the hierarchy, we can have $C_2$ followed by a stronger IP boundary. IP boundaries are found, for example, between dislocated elements and the rest of the sentence. Here schwa omission becomes categorical (therefore necessarily less likely than with a MPP boundary): epenthesis is excluded and all consonant clusters are tolerated on the surface.

Let us now illustrate with a specific example the correlation between the likelihood of schwa omission, or the extent to which consonants are allowed to appear without an adjacent vowel, and the strength of the following prosodic boundary. The segmental context is held constant. In (83) we have the sequence ...kt ] m..., with [t] followed by an increasingly stronger boundary, from Ø (no boundary) to IP. When [t] is followed by a null boundary, e.g. inside a clitic sequence like *que te moucher* (83a), it requires the support of an adjacent vowel, hence

epenthesis. If it is followed by an IP-boundary, no epenthesis takes place (83e). With a weaker following boundary – MPP, SPP, PW – [t] may surface in interconsonantal position but schwa insertion is also an option, used with decreasing frequency as we go up the prosodic hierarchy (83b-d).

(83)    EFFECT OF THE FOLLOWING BOUNDARY ON THE BEHAVIOR OF SCHWA:
        *[kt* ]$_i$ *m]*, with $i \in \{ Ø, PW, ...IP \}$

|  | | | |
|---|---|---|---|
| | a. C$_2$ ]$_Ø$ | *tu fais que te moucher* | 'you only blow your nose' |
| | | /ty=fɛ k=t=muʃe/ | *[tyfɛktmuʃe]  [tyfɛk(ə)t(ə)muʃe] |
| cluster | b. C$_2$ ]$_{PW}$ | *infecte manteau* | 'stinking coat' |
| more | | /ɛ̃fɛkt mɑ̃to/ | [ɛ̃fɛkt(ə)mɑ̃to] |
| easily | c. C$_2$ ]$_{SPP}$ | *insecte marron* | 'brown insect' |
| tolerated | | /ɛ̃sɛkt marɔ̃/ | [ɛ̃sɛkt(ə)marɔ̃] |
| | d. C$_2$ ]$_{MPP}$ | *l'insecte mangeait* | 'the insect was eating' |
| | | /l=ɛsɛ̃kt mɑ̃ʒɛ/ | [lɛ̃sɛkt(ə)mɑ̃ʒɛ] |
| | e. C$_2$ ]$_{IP}$ | *l'insecte, mets-le là* | 'the insect, put it there' |
| | | /l=ɛ̃sɛkt mɛlœla/ | *[lɛ̃sɛktəmɛlœla]  [lɛ̃sɛktmɛlœla] |

The same hierarchy can be established for preceding rather than following boundaries. Holding the segmental context to [...ktf...], we can have [t] preceded by an increasingly stronger boundary. I assume that clitics form a prosodic word with the word they attach to. So clitic junctures do not correspond to any prosodic boundary. The clitic /t/ embedded inside a clitic group, as in (84a), is therefore preceded by a null prosodic boundary. In this context the cluster [ktf] is not tolerated on the surface and epenthesis is obligatory. In a subject+object clitic+verb structure, the clitic is preceded by a MPP boundary (84b); following a dislocated element, [t] is preceded by an IP boundary (84c). In both cases schwa is optional at the clitic boundary, but it is more likely to be omitted when the preceding consonant is adjacent to a stronger boundary IP.

(84)    EFFECT OF THE PRECEDING BOUNDARY ON THE BEHAVIOR OF SCHWA:
        *[k* $_i$*[t f]*, with $i \in \{ Ø, PW, ...IP \}$

|  | | | |
|---|---|---|---|
| | $_Ø$[ C$_2$ | *tu fais que te faire mal* | 'you only hurt yourself' |
| cluster | | /ty=fɛ k=t=fɛr mal/ | *[tyfɛktfɛrmal]  [tyfɛk(ə)t()fɛrmal] |
| more | $_{MPP}$[ C$_2$ | *Jean-Luc te fait mal* | 'J. hurts you' |
| easily | | /ʒɑ̃lyk t=fɛ mal/ | [ʒɑ̃lykt(ə)fɛmal] |
| tolerated | $_{IP}$[ C$_2$ | *Jean-Luc, te fais pas mal!* | 'J., don't hurt yourself!' |
| | | /ʒɑ̃lyk t=fɛ pa mal/ | [ʒɑ̃lykt(ə)fɛpamal] |

**2.4. CONCLUSIONS**

The French schwa illustrates forcefully the shortcomings of the syllabic approach. The distribution of schwa is subject to an extremely complex interaction of factors, and the syllable seems unable to provide meaningful generalizations or reveal any order in this apparent jungle. The sequential generalizations proposed in the previous chapter provide more insight in the process of vowel deletion and epenthesis in French and constitute the main segmental factors in the behavior of schwa: the desirability for consonants, in particular stops, to be adjacent to a vowel, the Sonority Sequencing Principle, the role of contrast and prosodic boundaries, and, for stops, the effect of the continuancy value of the following element.

These segmental factors interact with each other in complex ways. As a general rule, factors facilitating the licensing of consonants in the absence of an adjacent vowel (contrast, strong prosodic boundary, non-stop consonants, etc.) have a cumulative effect on the likelihood of schwa insertion and retention: the more such factors are present, the less probable schwa insertion/retention is. The formalism developed in the following chapter can account for these aspects of the distribution of schwa, as well as for the inherent variability of the process. But a complete and integrated analysis of the behavior of this vowel involves additional factors, notably morphological, lexical, and rhythmic. A discussion of these factors and the way they interact with segmental ones is beyond the scope of this dissertation, so I do not undertake here a complete formal account of the French schwa, which I leave for future work.

# Chapter 3

## BASIC THEORETICAL ELEMENTS

## AND THEIR PERCEPTUAL MOTIVATIONS

The preceding chapter identified a number of empirical generalizations, which condition the application of consonant deletion, vowel epenthesis, and vowel deletion. These output generalizations are summarized below.

*Generalization 1:*    Consonants want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 2:*    Stops want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 3:*    Stops that are not followed by a [+continuant] segment want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 4:*    Consonants that are relatively similar to a neighboring segment want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 5:*    Consonants that are not at the edge of a prosodic domain want to be adjacent to a vowel, and preferably followed by a vowel.

*Generalization 6:*    Coronal stops want to be followed by a vowel.

The likelihood that a consonant deletes or triggers vowel epenthesis correlates with the degree to which it is subject to these constraints. Likewise, the likelihood that a consonant blocks vowel deletion correlates with the degree to which it would be subject to these constraints if deletion applied.

I argue that these generalizations have a perceptual motivation and follow from a general principle of perceptual salience:

(1)    PRINCIPLE OF PERCEPTUAL SALIENCE:
         All segments are perceptually salient.

The perceptual salience of a segment – or its degree of confusability with zero – is a function of the quantity and quality of the auditory cues that signal its presence in the speech stream. The best cues to consonants, apart from those present in the consonants themselves, are found in neighboring vowels, especially in the CV transition. It is the desirability for consonants to benefit from these vocalic cues that generalization 1 expresses. But cues may also come from other sources, and the perceptibility of a consonant without the support of an adjacent or following vowel depends on these non-(pre)vocalic cues. Generalizations 2-6 identify factors that negatively affect these cues, and consequently enhance the desirability of an adjacent vowel in order to meet the principle in (1).

I assume that consonant deletion and vowel epenthesis are motivated by the principle of perceptual salience; they apply when a consonant lacks perceptual salience and becomes more easily confusable with nothing, that is when the cues that permit a listener to detect its presence are diminished. Deletion removes such deficient segments, epenthesis provides them with the needed additional salience. Likewise, vowel deletion is blocked when it would leave a consonant with a reduced salience. Maintaining the vowel avoids removing cues that are crucial to that consonant. The link between vowel epenthesis and increase in salience has been investigated for Dutch by Donselaar et al. (1999). Dutch has an optional process of epenthesis in word-final consonant clusters, e.g. the word *film* is pronounced [film] or [filə̱m]. Donselaar et al. find that lexical access is significantly faster when the epenthetic vowel is present than when it is not. They argue that this is due to the increased salience or perceptibility that the vowel provides to its surrounding consonants, a finding that is supported by a phoneme-detection experiment in the last section of the paper.

I hypothesize that there is a direct relation between the perceptibility scale of consonants and the likelihood that they delete, trigger vowel epenthesis, or block vowel deletion. In other words, the likelihood that a certain consonant deletes, triggers epenthesis, or block vowel deletion correlates with the quality and quantity of the auditory cues associated to it in a given context.

I propose that the principle of perceptual salience is encoded in the grammar by means of markedness and faithfulness constraints that militate against consonants that lack auditory salience. These perceptually-motivated constraints are projected from observable phonetic properties in the course of acquisition (Hayes 1999; Steriade 1999d). The analysis is cast in Optimality Theory (Prince & Smolensky

1993; for recent overviews of the theory, see Archangeli & Langendoen 1998 and Kager 1999).

In this chapter I present the phonetic motivations that underlie the six generalizations above (3.1) and develop a constraint system that derives these generalizations and yields the desired patterns of consonant deletion, vowel epenthesis, and vowel deletion. I argue that both markedness and faithfulness constraints encode perceptual factors. I also discuss a number of issues that this perceptually-motivated analysis raises, notably the role of phonetics and perception in synchronic phonology and the treatment of variation in Optimality Theory. I end the chapter with two case studies that I use to illustrate the functioning of the constraint system I propose. Lenakel epenthesis introduces the role of markedness constraints, whereas consonant deletion in Sranan highlights that of the perceptually-based faithfulness constraints.

### 3.1. PERCEPTUAL MOTIVATIONS

I argue that the generalizations observed in patterns of consonant deletion, vowel epenthesis, and vowel deletion have a perceptual motivation: less salient consonants are more likely to delete, trigger vowel epenthesis, or block vowel deletion. The identification of consonants relies on a number of acoustic cues, which can be grouped into two categories: internal cues produced during the closure part of the consonant, and contextual cues that originate from neighboring segments. In addition, an important cue to stops is their release burst, which can be thought of as sharing characteristics of both internal and contextual cues: the burst is an inherent part of the production of stops, which relates it to internal cues, but its audibility depends on the nature of the following segment, like contextual cues. (See Wright 1996 for a summary of available cues to consonants' place and manner of articulation).

The whole system rests on the privileged status of CV transitions. Consonants are optimally salient before a vowel, and non-optimally salient in any position that lacks these transitions. Whether or not non-optimal consonants are tolerated depends on the quality and quantity of their non-CV cues and the language-specific degree of tolerance for less salient consonants. The six generalizations presented at the outset of this chapter are elucidated in terms of internal cues, contextual cues, modulation in the acoustic signal, and cue enhancement at edges of prosodic domains.

### 3.1.1. CV AND VC TRANSITIONS

*Generalization 1:*     Consonants want to be adjacent to a vowel, and preferably followed by a vowel.

The first generalization – consonants want to be adjacent to a vowel, and preferably followed by a vowel – stems from the major role played by vocalic transitions in the perception of consonants, and the dominance of the CV transitions over the VC ones. Formant transitions from and to adjacent vowels provide optimal contextual cues to consonants because of their high amplitude and dynamic pattern which gives information about the changing configuration of the vocal tract. They provide cues to all aspects of the articulation of consonants: manner, place, and laryngeal settings. This explains why consonants want to be adjacent to at least one vowel (VC or CV). The significance of these transitions for the perception of consonants is summarized as follows by Delattre (1961/1966: 407):

> Les transitions de formants jouent, dans la perception de la parole, un rôle autrement plus important que ne le laisserait entendre le choix peu heureux du terme "transition". Au lieu d'être une phase secondaire ou négligeable, comme on l'a longtemps cru, les transitions sont à la clef même de la perception de la consonne.

There is, however, a significant difference between VC and CV transitions. An important body of research points to the privileged status of CV sequences, as opposed to VC ones (e.g. Fujimura et al. 1978; Ohala & Kawasaki 1985; Ohala 1990, 1992; Sussman et al. 1997; Dogil 1999; Joanisse 1999; Krakow 1999; Warner 1999). Everything else being equal, consonants have better contextual cues in prevocalic than in postvocalic position. The relative weakness of postvocalic cues certainly constitutes the main factor involved in one of the most firmly established generalizations in phonology: the general preference for consonants to appear in onset rather than in coda position. It also provides an explanation for the asymmetrical behavior of several deletion, weakening, debuccalization, or assimilation processes in phonology, which typically target postvocalic consonants and VC sequences.[1]

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[1] The asymmetry between CV and VC could also explain statistical patterns in CVC words in English. Kessler & Treiman (1997) analyzed the distribution of phonemes in 2001 CVC English words. They found a significant connection between the vowel and the following consonant – certain vowel-coda combinations being more frequent than expected by chance – but no associations between the initial consonant and the vowel.

The perceptual advantage of CV transitions over VC ones is reflected in a number of experimental results. First, perceptual experiments have shown that when faced with contradictory transitions from the preceding and the following vowels in a VCV context, listeners mainly rely on the CV ones (Fujimura et al. 1978; Ohala 1990). Consonants are also identified much more rapidly with CV cues than VC ones (Warner 1999).

What is the source of this asymmetry? A number of differences between CV and VC sequences have been established, which all point to the enhanced perceptibility of prevocalic consonants. Ohman (1966) and Kawasaki (1982) have shown that VC formant transitions for different consonants are not as spectrally well differentiated among themselves as CV transitions. It follows that consonants are better contrasted with each other in prevocalic than in postvocalic position. We also know that the onset of a stimulus signal has a greater impact on the auditory system that its offset. It gives rise to a marked burst of activity of the auditory nerve fiber (see Wright 1996). This holds for linguistic stimuli as well, and provides a perceptual advantage to post-consonantal transitions cues: the onset of formants (those at the CV juncture) are amplified in a way that their offset (those at the VC juncture) are not. In addition, stop release bursts, an important cue to stops, occur in CV but not necessarily in VC contexts.

The auditory advantage of CV transitions seems to be reinforced by the articulatory patterns in CV vs. VC sequences. This research is reviewed by Krakow (1999) and provides consistent results.[2] First, there is more coarticulation or overlap between a consonant and a preceding vowel than between it and a following vowel. In other words, there is a more precise timing of articulatory movements in CV sequences. For example, velic lowering in [m] occurs earlier with respect to the onset of the labial constriction in postvocalic than in prevocalic position; in CV sequences both gestures are synchronized. Therefore, the nasality of the consonant spreads to the preceding vowel more than to the following one. Likewise for laterals, which involve both a tongue dorsum and a tongue tip articulation (in English): it has been observed that the tongue dorsum raises earlier with respect to the tongue tip in VC than in CV contexts. Second, prevocalic consonants have a more extreme

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[2]Krakow (1999) nicely summarizes the coarticulation results. She presents her results in syllabic terms – coda vs. onset consonants – and interprets the coarticulatory differences between them as reflecting syllabic organization. Notice, however, that the data used to derive these results never contrast only in syllable structure: they can all be described in terms of prevocalic vs. postvocalic consonants and domain-internal vs. domain-edge consonants. To the extent that reference to larger domains is necessary anyway – and this is clear in numerous studies cited by Krakow – the role of the syllable becomes unclear. The syllable could be a perceptual side-effect of the articulatory organization, not its origin (see Ohala 1992).

consonantal articulation than postvocalic ones. They are produced with a tighter constriction; for example, postvocalic laterals show a weaker constriction between the tongue and the palate than prevocalic ones. Nasals are also more sonorant in postvocalic position in that they are associated with a lower velic position and longer low velic plateaus. These two articulatory properties have an increasing effect on the amount of nasal airflow, making postvocalic nasals indeed more sonorant-like or less obstruent-like than prevocalic nasals.

Increased constriction and reduced coarticulation both enhance the contrast between the consonant and the following vowel. They maximize the alternation between a closed consonantal constriction and an open vocalic articulation; they also keep the two segments more distinct by reducing the overlap between them. Although the precise perceptual effects of these articulatory properties need further investigation, one expects a correlation between the maximization of the articulatory and acoustic contrast between the consonant and the following vowel. This in turn positively affects the perception of the segments involved, since their salience is largely determined by the degree of modulation in the acoustic signal (see section 3.1.4).

### 3.1.2. INTERNAL CUES AND THE GREATER VULNERABILITY OF STOPS

| *Generalization 2:* | Stops want to be adjacent to a vowel, and preferably followed by a vowel. |
|---|---|

The second generalization states that stops, more than other consonants, need an adjacent vowel, preferably a following one. The greater tendency of stops to delete, trigger epenthesis, or block deletion stems from the weakness of their non-CV cues. Consonants that lack the cues present in the CV transition have to rely more on other cues, which happen to be weaker for stops. Stops then suffer more than other consonants from not appearing in prevocalic position.

The special status of stops stems from two elements: the weakness of their internal cues and the audibility of their release burst. Stops have weak or no internal cues produced during closure. Due to the absence of oral or nasal airflow, this part of the segment is silent or associated only with low-amplitude vocal fold vibrations, and provide very weak (internal) cues.[3] The non-internal perceptual cues to stops are rather concentrated in their release burst, whose importance in the perception of

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[3]Voiced stops are often not accompanied by vocal fold activity and the corresponding voicing bar, especially in postvocalic position. Periodicity in the signal therefore does not constitute a reliable cue to voiced stops (Wright 1996; Steriade 1999c).

stops has often been reported (see numerous references in Wright 1996: 5 and Clark & Yallop 1995: 282). But non-prevocalic stops do not reliably benefit from an audible release burst, as noted in the previous section, and the absence or weakness of the burst may severely reduce their salience and perceptibility. Thus the disadvantage of VC cues against CV ones is amplified in the case of stops as opposed to other consonants.

By contrast, nasals, fricatives, and liquids have relatively robust internal cues. Fricatives have frication noise, sonorants have formant structure. So they remain perceptible even in the absence of transition cues. The contrast between segments with and without internal cues (stops vs. other consonants) is not only apparent in deletion and epenthesis processes. It also affects the articulatory timing in the production of consonant clusters. Wright (1996) studied in detail the production of word-initial and word-internal consonant clusters in Tsou. He noticed that stops that lack transitional cues are produced in such a way as to maintain an audible release burst, which implies a smaller degree of overlap with the following consonant. Other consonants – those with internal cues – in the same context, however, overlap more with adjacent consonants, presumably because their internal cues are salient enough. To maintain a sufficient degree of perceptibility in the absence of flanking vowels, a stop thus tends to involve more articulatory energy.[4]

A distinction should be made, however, between strident and non-strident fricatives with respect to internal cues. Non-strident fricatives are associated with noise of low amplitude, often not detectable on normal spectrograms. Miller & Nicely (1955) show that the distinction between stops and the weak fricatives becomes unreliable in masking noise. This distinction is indeed reflected in deletion patterns, which further supports the perceptual basis of deletion processes. The historical loss of non-strident fricatives is common, but [s] and [ʃ] are generally more resistant. Non-strident fricatives may pattern with other fricatives with respect to deletion / epenthesis (the more common case in this dissertation) or with stops. The Icelandic pattern reviewed in chapter 1 provides just one example of the latter situation. I will not, however, discuss the behavior of non-strident fricatives in this dissertation, focussing only on stops.

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[4]See Rhee (1998) for a discussion of the role of release in various phonological patterns.

### 3.1.3. THE AUDIBILITY OF RELEASE BURSTS

*Generalization 3:*    Stops that are not followed by a [+continuant] segment want to be adjacent to a vowel, and preferably followed by a vowel.

The role of the [continuancy] value of the following element on stop deletion can be related to the audibility of the release burst. There is a well-known tendency for stops to be unreleased or to lack an audible release in certain contexts. Based on Henderson & Repp (1982), we can usefully distinguish between stops with and without a release that has an observable effect in the acoustic signal. Stops without an acoustically present release actually comprise two distinct types: strictly unreleased and silently-released stops. Articulatorily unreleased stops occur before homorganic nasal or oral stops and utterance-finally. In the first case the constriction is maintained through the following consonant; utterance-finally it may be delayed. Silently-released stops are found before an oral or nasal stop with a more front articulation. When the closure of the second consonant is made before the release of the first stop, this release has no acoustic effect since the air is trapped behind the front constriction (see also Laver 1994: 359-360).

Unreleased and silently-released stops, however, are not found if the stop is followed by a segment that does not involve a complete closure in the oral cavity, since there is always an outgoing flow of air that can carry the effect of the release. Such segments correspond to the class defined by the specification [+continuant]. We can therefore establish a basic opposition between [+continuant] segments and the rest ([-continuant] segments and final position) with respect to the acoustic effect of a preceding stop release: it is necessarily present when the stop is followed by a [+continuant] segment. Since the release burst plays an important role in the perception of stops, it is advantageous to ensure that the release will not be devoid of an acoustic effect; being followed by a [+continuant] segment is one way to achieve this goal.[5]

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[5]It must be noticed, however, that a release burst may be acoustically present but so weak that it is not perceived or not reliably perceived by listeners. As is made clear in Henderson & Repp (1982), a binary opposition between "released" and "unreleased" stops is insufficient and potentially misleading: the audibility of an acoustically present release is a gradual phenomenon, which ranges from inaudible to very salient, with various intermediate cases. This depends on various aspects of the segmental and prosodic context and on the articulatory timing. The basic opposition between the absence and presence of an acoustic effect of the release must be supplemented by additional factors that determine its level of perceptibility, but I do not carry out this task here.

### 3.1.4. CONTRAST AND MODULATION IN THE ACOUSTIC SIGNAL

*Generalization 4:*    Consonants that are relatively similar to a neighboring segment want to be adjacent to a vowel, and preferably followed by a vowel.

The role of similarity or contrast in combinations of segments is explained by the correlation between the amount of acoustic modulation in a sound sequence and its perceptual salience (e.g. Kawasaki 1982; Ohala & Kawasaki 1985; Wright 1996; Boersma 1998). The auditory system gets rapidly "bored" or "numbed" and is little responsive to continuous stimuli. It therefore needs constant variation and the greater the modulation, the greater the salience, the more easily perceptible the segments involved are. Modulation is measured in terms of "the magnitude, rate and the number of stimulus parameters varying simultaneously" (Ohala & Kawasaki 1985: 116). Factors involved in the computation of modulation include differences in sound intensity or amplitude and variation in the spectrum. More specifically we may look at formant frequency, relative formant amplitude, overall spectral energy, and periodicity in the signal.

The necessity of modulation for perception is not specific to linguistic signals. Analogies with other perceptual systems are easy to find. Boersma (1998) uses a cartographical metaphor: in a country map, adjacent countries have to be represented in distinct colors if they are to be easily recognized as different entities. More generally, the production of modulations in some carrier signal can be viewed as "the essence of any communication channel" ( Ohala & Kawasaki 1985: 123).

In predicting and explaining phonotactic patterns, however, modulation interacts with many other factors, in particular articulation, the way the perceptual system responds to certain properties of the acoustic signal, and the risk of confusability between different sound sequences that are acoustically similar. But we can hypothesize that, everything else being equal, sound combinations displaying a greater modulation in a given dimension are perceptually better, and are predicted to be more common, than other sequences with a smaller modulation in the same dimension. Likewise, sequences containing modulation in a larger number of dimensions are preferable to sequences with modulation in fewer dimensions. This can be transposed in featural terms, to the extent that features are associated with some acoustic contrast: a segment that contrasts in *n* features with its neighboring segments is more perceptible than a segment that contrasts in *n-1* features (again, everything else being equal). This will be the rationale of the constraint system developed below.

The role of acoustic modulation in explaining the crosslinguistic frequency of certain phonotactic patterns and combinations of segments has been investigated in particular by Kawasaki (1982) and Kawasaki-Fukumori (1992). She explored the following sequences: stop-liquid, stop-glide, stop-vowel, and vowel-stop. The hypothesis tested was whether the relative rarity of certain combinations within these groups could be motivated by acoustic/auditory constraints, in particular the lack of acoustic modulation within the sequence. The disfavored combinations are assumed to be:
- dental stop + /l/
- labial consonant + /w/
- alveolar-palatal consonant + /j/
- sequences of a labial or labialized consonant and a rounded vowel
- sequences of an alveolar/palatal or palatalized consonant and a front vowel
In addition, CV sequences are generally prefered to VC ones.

To test this hypothesis, selected CLV, CGV, CV, and VC sequences were recorded. The most influential parameter in acoustic modulation was taken to be the changes in the frequencies of the first three formants. The salience of a given sequence was approximated by the sum of the distance in frequency of these formants.

The results support the hypothesis to a large extent. Labial consonant + /w/ and alveolar-palatal consonant + /j/ clusters show little spectral modulation. This is also true of sequences of a labial or labialized consonant and a rounded vowel and sequences of an alveolar/palatal or palatalized consonant and a front vowel. The relative markedness of these combinations is therefore compatible with a perceptually-based motivation. In general, as noted in section 3.1.1, VC syllables are also spectrally closer among themselves than CV syllables, so consonants are better contrasted with each other in prevocalic than in postvocalic position, in accordance with Ohman's (1966) results.

The case of dental stop + /l/ clusters is not explained by the acoustic modulation hypothesis. In general, we observe more modulation in stop+/r/ than in stop+/l/ clusters, which is compatible with stop+/r/ sequences being less restricted crosslinguistically than stop+/l/. But if we look at stops with different points of articulation, we see that the clusters of a stop and a liquid show the least spectral change when the initial stop is bilabial and the greatest modulation in formant frequencies in /d/+liquid. This is unexpected and the modulation hypothesis clearly fails to predict the avoidance of /dl/ sequences in languages of the world. I do not have a reasonable alternative to propose and only notice that

formant trajectories are not the only determinant of salience and that other perceptual factors may be involved, notably the release burst and the general dispreference for alveolar stops in nonprevocalic position (see generalization 6, in section 3.1.6).

Janson (1986), however, contests the validity of Kawasaki's generalizations concerning CV sequences, specifically the dispreference for sequences of a labial or labialized consonant and a rounded vowel and alveolar/palatal or palatalized consonant and a front vowel. By looking at a sample of five unrelated or distantly related languages, Janson actually reaches opposite conclusions: the favored sequences are alveolar consonant+front vowel and labial consonant+back rounded vowel. He suggests that these tendencies are to be explained by articulatory factors: the prefered CV sequences are those that require smaller articulatory movements. Kawasaki's generalizations, then, would hold only for /w/ and labialized consonants + rounded vowels and /j/ and palatalized consonants + front vowels. These sequences are indeed disprefered and acoustic/auditory lack of modulation is probably the relevant factor.

Janson's statistical results, however, were reanalyzed by Maddieson & Precoda (1992), who ended up with no clear trend in any direction. They found no preference or dispreference for specific CV combinations, with two salient exceptions: sequences of a glide followed by the corresponding vowel and velar consonants before high front vowels. The first probably follows from Kawasaki's modulation hypothesis, the second from articulatory considerations. What can we conclude from these results? It may well be the case that the frequency of CV sequences is relatively uninfluenced by phonetic factors of the kind Kawasaki and Janson have proposed. But this conclusion, I believe, does not extend to contexts other than CV. I would like to suggest that CV sequences, with the exception of combinations such as /wu/ and /ji/, all generally involve large spectral modulation. Their perceptibility may be beyond the level found desirable in most languages, and the distinctions in spectral change found between different CV combinations may become largely irrelevant. In other words, CV sequences are all good enough and speakers/listeners may not prize additional modulation high.

In this dissertation I am concerned with combinations of consonants, which generally show less modulation than CV sequences. I suggest that differences in amplitude and spectral variations here play a decisive role and may really determine the fate of particular sequences. It is in these less prefered segment combinations that the impact of auditory similarity is likely to reveal itself. I believe the patterns described here support this idea.

## 3.1.5. CUE ENHANCEMENT AT EDGES OF PROSODIC DOMAINS

*Generalization 5:*  Consonants that are not at the edge of a prosodic domain want to be adjacent to a vowel, and preferably followed by a vowel.

The salience of consonants depends upon their position in the prosodic structure. It is by now well-established that segments at edges of prosodic constituents, from the word to the utterance, are associated with processes that enhance their salience. Specifically, edge consonants benefit from articulatory strengthening, lengthening, and reduction in the amount of overlap with the segment across the boundary, processes that are assumed to increase their perceptibility. Studies that have investigated these processes include: Oller (1973); Klatt (1975, 1976); Cooper & Danly (1981); Beckman & Edwards (1990); Wightman et al. (1992); Byrd (1994); Fougeron & Keating (1996, 1997); Gordon (1997); Keating et al. (1998); Fougeron (1999); Turk (1999); Byrd et al. (2000).

Consonants at the right and left edges behave differently; both edges benefit from cue enhancement, but through different processes. The right edge is mainly associated with segment lengthening, but is not characterized, or only marginally so, by articulatory strengthening. By contrast, the left edge involves articulatory strengthening (e.g. tighter constriction), with lengthening apparently playing a secondary role in that position. Reduction of overlap across prosodic boundaries is obviously symmetrical since it affects the final segment of the first constituent and the initial one of the following constituent. It has also been established that these effects are cumulative as we go up the prosodic hierarchy; that is, we observe more initial strengthening, final lengthening, and reduction of overlap at higher boundaries than lower ones.

There are only a handful of studies of gestural overlap between segments separated by different levels of junctures. I refer to Byrd et al. (2000) for a summary of these studies, which "suggest that phrasal position is a significant force in constraining the degree of temporal overlap between articulatory gestures."

Studies that confirm domain-final lengthening are numerous, e.g. Oller (1973), Klatt (1975, 1976), Cooper & Danly (1981), Beckman and Edwards (1990), Wightman et al. (1992), Turk (1999), and additional sources cited in the last two references. See also Edwards et al. (1990) and Beckman et al. (1992) for the articulatory mechanisms involved in final lengthening. Turk (1999) establishes that final lengthening targets predominantly the coda, that is the last consonant(s), which is lengthened in phrase-

final position in her corpus by almost 200%. The preceding nucleus vowel is also lengthened, but to a much lesser extent (around 65%), while the onset of the domain-final syllable is only marginally affected (around 12%).

Stops, however, contrast with other consonants. My own analysis of a corpus very similar to that used by Turk (1999) suggests that lengthening affects stops much less than other consonants.[6] This corpus allows us to directly compare the words Duke /duk/ and Maine /men/ in phrase-final and phrase-medial position. For phrase-final /men/, we observe an increase in duration of about 155% for the coda /n/ vs. 59% for the preceding nucleus. These numbers are comparable to those provided by Turk, but they contrast dramatically to those obtained for phrase-final /duk/. In this case, the nucleus /u/ lengthens relatively more than the coda /k/: 104.5% vs. 32.2%.[7] This confirms Klatt's (1976: 1213) observation that stops tend not to lengthen as much as other consonants at phrase boundaries. This may be related to the fact that maintaining a stop closure for a longer period of time demands relatively more effort than maintaining the constriction for other consonants. In utterance-final position, Cooper & Danly (1981) found that the percentage of lengthening for alveolar and labiodental fricatives in English ranges from 79% for /v/ to 167% for /s/, that is also substantially more than what I found for stops. This is not to say that stops are not affected as much as other consonants in phrase-final position: I rather believe that the main difference for them lies in the strength and audibility of their release burst (see below) more than in their lengthening.

Wightman et al. (1992) is the most detailed study of the correlation between the amount of lengthening and the strength of the following boundary. They use seven different break indices or boundaries, with increasing strength from 0 to 6. A break index of 0 is assigned between two orthographic words where no prosodic break is perceived, the break index 6 marks sentence boundaries. Intermediate break indices can variably be related to other prosodic units cited in the literature (prosodic word, accentual phrase, intermediate phrase, intonational phrase, etc.), but no exact correspondence is established (see the discussion on p. 1710). The amount of lengthening for a segment is expressed in terms of normalized duration, which is

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[6]This analysis was performed on a corpus provided by Stefanie Shattuck-Hufnagel as part of the course "Laboratory in the physiology, acoustic and perception of speech" taught at MIT by Ken Stevens, Joe Perkell, and Stefanie Shattuck-Hufnagel in the fall of 1999.

[7]It is interesting to observe, though, that the increase in the rime phrase-finally is very similar for both words: 73.8% for *Maine* and 68.1% for *Duke*. This suggests that phrase-final lengthening primarily targets the rime, and that there are compensation effects between the nucleus and the coda depending on the lengthenability of the coda consonant. The distribution of the increase in duration within the rime apparently tends to concentrate on the coda consonant, unless it is a stop. In this case, the nucleus carries most of the lengthening.

a measure of deviation from an expected value, taken to be 0.[8] They find that domain-final consonants are longer and longer as we go from a break index 0 to a break index 5. The strongest index 6 does not involve any additional lengthening with respect to the immediately preceding level. As we will see again, the absence of a contrast between the end of the utterance and the end of the immediately preceding level (standardly the Intonational Phrase or IP) is a recurrent result of the phonetic studies of edge segments.[9] The average normalized durations of consonants, depending on the level of the following break index (0 to 5), are given below. These numbers are approximations taken from the first graph in figure 4 (p. 1714). By contrast, Wightman et al. (1992) found no correlation between the duration of domain-initial consonants and the size of the preceding boundary.

(2)     CONSONANT DURATION IN DOMAIN-FINAL POSITION:

| Break index: | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Normalized duration of the final consonant: | -0.5 | -0.2 | -0.1 | 0.2 | 0.5 | 0.85 | 0.6 |

Fougeron & Keating (1997) also report an effect of the phrase-final position on articulation, in an experiment involving reiterant speech with /no/ syllables: phrase-final vowels are more open than phrase-medial ones. This result was interpreted in terms of strengthening, since openness for vowels indicates a more extreme articulation. But they found no correlation between the degree of openness and the strength of the following boundary: final /o/'s above the word level are simply always quite open, irrespective of the strength of the boundary. Thus there is no cumulative effect, unlike in final lengthening. More importantly, no similar strengthening has been reported for consonants, which most particularly concern us here.

Articulatory strengthening in initial position is a recent area of investigation, studied in particular in Pierrehumbert & Talkin (1992); Dilley et al. (1996); Fougeron & Keating (1996, 1997); Gordon (1997); Keating et al. (1998); Fougeron (1999); Byrd et al. (2000). Strengthening manifests itself differently in different classes of consonants, but it can be viewed as always resulting in a more consonant-like articulation, that is less sonorant and/or involving a tighter constriction.

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[8]A negative normalized duration means that the segment is shorter than average; a positive one means that the segment is longer than average.

[9]If we interpret lengthening as a cue to prosodic boundaries, we may think that additional lengthening in the case of the utterance is unnecessary since other more salient cues are available, notably pauses.

Pierrehumbert & Talkin (1992) found that initial /h/ is more consonant-like when it is phrase-initial than when it is phrase-medial, the degree of consonantality being measured by the amount of breathiness and the corresponding degree of glottal opening. Similar results were obtained for the glottal stop. Glottalization of word-initial vowels was further investigated by Dilley et al. (1996), who found that it is more frequent at the beginning of large prosodic constituents (Intonational Phrase) than at the beginning of lower domains (Intermediate Phrase), and least likely phrase-medially. These findings are interpreted in terms of strengthening, greater gestural magnitude and increase in consonantality associated with the onset of prosodically significant domains.

Fougeron & Keating (1996, 1997), Gordon (1997), Keating et al. (1998), and Fougeron (1999) are concerned with linguopalatal contact and/or nasal flow in initial oral and/or nasal alveolar stops in various domains, from the word to the utterance. These studies consistently establish a correlation between the strength of the boundary preceding the consonant and the amount of linguopalatal contact, measured by the number of electrodes contacted on an artificial palate in EPG experiments. The identity and, to a lesser extent the number, of the prosodic domains that can be consistently distinguished by the amount of contact varies from speaker to speaker, but the general trend is invariant. As in the lengthening data presented in (2), the Utterance is not generally distinguished from the Intonational Phrase. I use the French data analyzed in Fougeron & Keating (1996) as an example. I report below for their two speakers the percentage of electrodes contacted in the production of /t/ and /n/ at the beginning of syllables (word-internal), words, accentual phrases, intonational phrases, and utterances (approximated from the graphs in figure 4).

(3)    CONSONANTAL CONSTRICTION IN DOMAIN-INITIAL POSITION:
       Average maxima of linguopalatal contact for /t/ and /n/ at the left edge of increasingly strong prosodic domains (from Fougeron & Keating 1996):

|           |      | Syllable | Word | AP | IP | U |
|-----------|------|----------|------|----|----|---|
| Speaker 1 | /n/  | 40       | 44   | 49 | 56 | 57 |
|           | /t/  | 51       | 54   | 56 | 60 | 62 |
| Speaker 2 | /n/  | 47       | 52   | 58 | 68 | 67 |
|           | /t/  | 54       | 55   | 63 | 69 | 66 |

Similar results are obtained for the amount of nasal airflow: nasals at the left edge of higher constituents are associated to a reduced amount of nasal airflow in comparison to nasals at the beginning of lower domains or in domain-internal position. Again, this is interpreted as an increase in consonantality. But the correlation with boundary strength is not as good as that obtained with linguopalatal contact, which appears to be more directly influenced by the prosodic position. The maxima of nasal flow in /n/ depending on the prosodic position for speaker 1 above are given below. The underlined numbers indicate the levels that are significantly distinguished by the amount of nasal flow, the other two not following the expected trend, although this is not surprising in the case of the utterance. (The other speaker had less consistent results, which differed with the identity of the adjacent vowels; they are not shown here.)

(4)    NASAL AIRFLOW IN DOMAIN-INITIAL POSITION:
       Average maxima of nasal flow (in ml/sec) for /n/ at the left edge of increasingly strong prosodic domains (from Fougeron & Keating 1996):

|           | Syllable | Word | AP | IP | U |
|-----------|----------|------|----|----|---|
| Speaker 1 | 48       | <u>69</u> | <u>60</u> | <u>47</u> | 59 |

Finally, a word should be said about lengthening in initial position of prosodic domains. Although certainly less prevalent than in constituent-final position, lengthening of initial consonants is reported in a number of studies, e.g. Oller (1973) and Pierrehumbert & Talkin (1992). In their detailed study of segmental durations at edges of prosodic domains, however, Wightman et al. (1992) found no correlation between the length of the initial consonant and the strength of the preceding boundary. Just like final strengthening, which was found to occur indistinctively in final positions above the word level, there could be a process of initial strengthening which affects all phrase-initial segments, irrespective of the level of the juncture.

The linguistic significance of these phonetic processes affecting edges of prosodic constituents – articulatory strengthening, lengthening, and reduction of overlap – is not yet entirely clear. We may think that they help with the segmentation of the signal into words and higher constituents, by signalling the presence of prosodic boundaries and providing cues to their strength (see Fougeron & Keating 1997). It seems clear that segment lengthening may be used by listeners to locate prosodic boundaries. Wightman et al. (1992) have shown that the degree of final lengthening enables listeners to distinguish at least 4 levels of prosodic domains. Strengthening and overlap reduction result in an enhanced contrast between the initial consonant and the adjacent segments. This enhancement process could also be interpreted by listeners as indicating the presence of a boundary. The amount of strengthening or contrast could even provide cues as to the strength of the boundary. Perceptual experiments are necessary, however, to assess the extent to which listeners use these phonetic variations for segmentation purposes.

Fougeron & Keating (1997) also suggest that initial strengthening may play a facilitating role in lexical access. It enhances the contrast between the initial segment and its neighbors. This increases the accessibility of segmental information in this position, which is welcome since initial segments are important in word recognition.

I would like to suggest a third area in which the phonetic correlates of domain-final and domain-initial positions impact the linguistic system: consonant licensing. Lengthening, increased articulatory energy, and less overlap enhance the salience of domain edges, and conspire to license more complex segments, a greater number of segments, and a wider variety of consonants in these positions. A strengthened and lengthened articulation correlates with more robust auditory cues, and those cues are not susceptible to weakening through overlap with a following segment. Stops and affricates are likely to particularly benefit from those effects, which facilitate the production of more strongly released bursts and increase their audibility through reduction of overlap. Since the burst constitutes an important element in the perception of these segments, we may think that the addition of the cues associated to it results in a radical shift upward in their perceptibility. In contrast, the effects of strengthening or lengthening may affect less radically the perceptibility of consonants other than stops and affricates, which does not so much depend on the release cues.

Since we observe a correlation between lengthening, strengthening, overlap, and the strength of the adjacent boundary, I predict that consonants are more easily licensed at edges of higher prosodic constituents than at edges of lower ones. This is indeed what we find in Hungarian degemination and the French schwa. Additional cases will be presented in chapter 5. Segments in word-internal position are not followed by any (relevant) prosodic boundary. Therefore they do not benefit at all from the advantages associated with domain edges, which explains their increased tendency to delete, trigger vowel epenthesis, and block vowel deletion.

**3.1.6. CORONAL STOPS AND F2 TRANSITIONS**

*Generalization 6:*      Coronal stops want to be followed by a vowel.

Our last generalization, illustrated by deletion and assimilation in Attic Greek (chapter 1), concerns coronal stops, which contrast with other stops in being particularly disfavored in non-prevocalic position. This issue has been addressed in a recent paper by Y. Kang (1999), who provides a perceptual explanation for the specific behavior of coronal stops. I rely entirely on her treatment in this section. The Attic Greek (and Latin) pattern was used to illustrate the shortcomings and the

syllabic approach to deletion and epenthesis, and Kang's explanation supports the perceptual alternative I advocate in this dissertation. This will exhaust what I have to say about the peculiarities of coronal stops.

In many languages coronal stops are more subject to deletion and assimilation than other stops in preconsonantal position. This is unexpected in view of the relative unmarkedness of coronals with respect to other places of articulation. Kang's explanation for this tendency is based on the role of F2 transitions in the perception of coronality and their distinct properties in prevocalic and postvocalic position. An important auditory cue to coronality lies in the F2 transitions. While F2 transitions from a coronal consonant to a following vowel (CV) are robust and clear, those from a vowel to a coronal (VC) are considerably weakened, almost nonexistent. There is little movement in F2 in the final 20 ms of the vowel. This acoustic fact is interpreted as the result of a weakening in the tongue body gesture, which plays a large part in shaping the F2 transition. This articulatory weakening makes coronals particularly vulnerable in (unreleased) preconsonantal position and subject to masking by the following consonant. Citing Byrd (1992) and Zsiga (1994) (see also Surprenant & Goldstein 1998), Kang notes that in $V_1C_1C_2V_2$ sequences, where $C_1$ is coronal, produced with extensive overlap between the two consonants, the vowel $V_1$ carries the cues to $C_2$ rather than those to the coronal $C_1$. What is perceived is thus $V_1C_2(C_2)V_2$. The masking of the transitions obviously affects stops more than other consonants since stops do not carry independent internal cues that could compensate for the weakness of the contextual ones.[10],[11]

**3.2. THEORETICAL APPARATUS**

The last section established that the optimal position for a consonant is the CV context, and enumerated a number of factors that influence the perceptibility of

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[10]Kang does not distinguish coronals in preobstruent vs. presonorant positions. We expect them to be more vulnerable before obstruents. Sonorants have a formant structure and may carry the needed F2 transition. But its amplitude is reduced in comparison with vowels, especially for nasals. We indeed find a three-way contrast between coronal stops in prevocalic, presonorant, and preobstruent position in Attic Greek: they are systematically avoided before obstruents, only marginally so before sonorants (see note 39 in chapter 1), and not at all before vowels.

[11]Coronal stops are not weaker than other stops in all languages. They may even be the only segments allowed in preconsonantal position, in particular in Australian languages (Hamilton 1996). These languages typically contrast different coronal places of articulation and Kang argues that the presence of this phonemic contrast, primarily cued by F2, forces speakers to maintain accurate tongue body positions in the production of coronals, even in postvocalic position. The F2 transition thus remains salient, and so does the consonant. In other cases, e.g. Finnish, all stops are consistently audibly released in all positions, providing sufficient cues to coronal stops even with a weakened tongue body gesture and F2 transition.

consonants: the presence of vocalic transitions, the amount of contrast with neighboring segments, the strength of the adjacent boundary (if any), the presence of internal cues, and, for stops, the audibility of the release burst.

These phonetic factors impact the grammar by motivating both markedness and faithfulness constraints. The focus is on a family of markedness constraints against non-prevocalic consonants, that is consonants that are not in a perceptually optimal position. These constraints interact with faithfulness constraints which encode the relative perceptual impact of a modification of the input. The perceptually-motivated constraint system I propose to account for the generalizations established in the preceding chapters raises a number of issues, which have to do with the role of perception, and more generally phonetic and functional factors, in phonology (3.2.1 and 3.2.4), and the integration of variation in Optimality Theory, which is crucial in the analyses to follow (3.2.5). I suggest in particular that the inclusion of perceptually-motivated constraints in the synchronic phonological system is intimately linked to the existence of variable processes.

### 3.2.1. PERCEPTION IN PHONOLOGICAL THEORY

As with many concepts in science, perception has gone through a cycle in phonological theory. In the opposition between perception and articulation, Jakobson, Fant & Halle (1952: 12) established the primacy of the former:

> The closer we are in our investigation to the destination of the message (i.e. its perception by the receiver), the more accurately can we gage the information conveyed by its sound shape. This determines the operational hierarchy of levels of decreasing pertinence: perceptual, aural, acoustical and articulatory (the latter carrying no direct information to the receiver).

The feature system they developed reflects this bias toward the auditory face of speech. The *Sound Pattern of English* (1968) constituted a radical departure from this position, as the distinctive features proposed by Chomsky & Halle are primarily articulatory in nature. The articulatory orientation has been maintained in subsequent work on distinctive features and feature geometry (e.g. Clements 1985; McCarthy 1988), and even reinforced in Sagey (1986) and Halle (1995) by direct reference to articulators in the definition and organization of features.

The fundamental role played by features in phonological description and analysis cannot but influence the range of topics investigated and the way we look at

them. For example, as discussed in Hura et al. (1992), articulatory features showed a clear advantage over acoustic/auditory ones in the treatment of assimilation processes (e.g. palatalization before high-front vowels, place assimilation of nasals). As a result, these processes are typically viewed in phonology as motivated by articulatory factors. Yet more phonetically-oriented research on assimilation has shown that perception is crucial in assimilatory processes (e.g. Kohler 1990; Ohala 1990; Hura et al. 1992, who provide additional references). By contrast, patterns that do not seem to be naturally expressible in terms of the standard articulatory-based features are more likely to be overlooked or analyzed in a more ad hoc fashion. See Flemming (1995) for numerous examples. The special vulnerability of stops in deletion and epenthesis patterns may also fall into this category.

In contrast with standard phonology, however, research made by or in collaboration with phoneticians continues to stress the role of perception in shaping sound patterns. Among the influential proposals highlighting the contribution of perceptual factors, one should mention: Liljencrants & Lindblom's (1972) work on the role of perceptual distance in the configuration of vocalic systems and Lindblom's (1986, 1990) Theory of Adaptive Dispersion (see also Joanisse & Seidenberg 1998); Stevens's (1972, 1989) Quantal Theory of speech; the theory of enhancement features (Stevens, Keyser & Kawasaki 1986; Stevens & Keyser 1989; Keyser & Stevens 2001); numerous works by John Ohala (e.g. 1981, 1983, 1992, 1993, 1995, etc.), as well as Kawasaki (1982) and Kawasaki-Fukumori (1992).

The recent development of Optimality Theory, however, is associated with a renewed interest in the phonetic – in particular perceptual – motivations of phonological patterns and their direct integration into phonological analyses. Indeed, it can be argued that a "serious coming to grips with phonetic functionalism" was not workable in pre-OT non-constraint-based approaches (Hayes 1999: 244). The old idea of sound patterns being the outcome of a competition between the demands of the speaker and the hearer – maximizing articulatory ease vs. the distinctiveness of contrast – has been reappropriated in much recent work, which cite such authors as Passy (1891, cited in Boersma 1999), Zipf (1949), or Martinet (1955). This functionally-motivated phonology has been advocated particularly forcefully in work conducted at UCLA (Flemming 1995; Jun 1995; Silverman 1995; Hayes 1999; Steriade 1999a,c,d, to appear; Kirchner 1998; Fleischhacker 2000a,c), to which we may add Hamilton (1996), Côté (1997a, 1999), Padgett (1997), Boersma (1998, 1999), Hume (1999), Y. Kang (1999, 2000), Kochetov (1999), and Hume & Johnson (to appear).

The sequential approach to deletion and epenthesis processes developed here pursues the line of reseach advocated in the above-cited works. It is both motivated

and constrained by direct reference to perceptual factors. It adopts more specifically the 'Licensing by cue' approach developed by Steriade (1999a,c).

In two important papers, Steriade (1999a,c) argues against the prosodic or syllabic approach to phonotactic processes, and develops an Optimality-theoretic account directly based on perceptual cues. Her hypothesis, refered to as 'Licensing by cue', is phrased as follows: "The likelihood that distinctive values of the feature F will occur in a given context is a function of the relative perceptibility of the F-contrast in that context" (Steriade 1999a: 4). In other words, retention of distinctive features in a given context correlates with the number and quality of the available perceptual cues to that feature in that context. Cues do not depend on syllable structure but on the nature of adjacent segments and boundaries. In her 1999c paper, Steriade applies this approach to laryngeal features; the 1999a one develops a more succint analysis of aspiration and place contrasts. I present here the voicing neutralization case, addressed in the first half of her 1999c paper (leaving aside issues of aspiration and ejection, dealt with in the second half). Kochetov (1999) applies Steriade's approach to palatalization; my own analysis of deletion and epenthesis can be interpreted as an extension of it to whole segments rather than features.

Obstruent devoicing and voicing neutralization have been considered classic examples of prosodically-driven feature-changing processes (e.g. Rubach 1990; Lombardi 1991, 1995, 1999; Bethin 1992; Gussmann 1992). They are described as dependent on syllabic affiliation, and typically apply in coda position. Steriade argues that the retention of distinctive voicing rather follows from the availability of possible cues to voicing in different contexts. The cues to the voicing specification of stops and the contexts where they can be found are summarized below; $V_1$ and $V_2$ correspond to the preceding and following vowel, respectively.

(5)     CUES TO VOICING CONTRASTS AVAILABLE IN DIFFERENT CONTEXTS
        (based on Steriade 1999C: 30-31):

| Cue | Context where it can be found |
| --- | --- |
| Closure voicing | Everywhere |
| Closure duration | Everywhere |
| $V_1$ duration | Only after sonorant |
| Fo and F1 values in $V_1$ | Only after sonorant |
| Burst duration and amplitude | Not before obstruents |
| VOT value | Before sonorant |
| Fo and F1 values at the onset of voicing in $V_2$ | Before sonorant |

We can then establish a hierarchy of contexts, from those that provide the most cues to voicing and in which voicing contrasts are best perceived, to those that provide the fewest cues and in which voicing contrasts are the least perceptible. This perceptibility scale is given below, with 'context x' → 'context y' being interpreted as context x is less favorable to the perception of voicing contrasts than context y.

(6)     HIERARCHY OF CONTEXTS FOR THE PERCEPTIBILITY OF VOICING CONTRASTS
        (based on Steriade 1999C: 35):
        O=obstruent          R=sonorant          #=final position
        O__O , #__O  →   O__#  →   R__O  →   R__#  →   __R  →   R__R

This scale projects a corresponding hierarchy of markedness constraints against the preservation of voicing contrasts, of the form *αvoice/X – do not maintain a voicing contrast in context X. The constraints are universally ranked according to the perceptibility of voicing values: the lower it is in a given context X, the higher ranked the constraint *αvoice/X is.

(7)     HIERARCHY OF MARKEDNESS CONSTRAINTS AGAINST THE PRESERVATION OF
        VOICING CONTRASTS (based on Steriade 1999C: 35):
        *αvoice/O__O, #__O       >>      *αvoice/O__#      >>      *αvoice/R__O
    >>      *αvoice/R__#            >>      *αvoice/__R      >>      *αvoice/R__R

These markedness constraints interact with a faithfulness constraint militating for the preservation of input [voice] values: PRESERVE [voice]. The position of PRESERVE [voice] within the hierarchy of *αvoice constraints will determine the contexts in which voicing neutralization applies or not. For example, if PRESERVE [voice] is inserted between *αvoice/R__# and *αvoice/__R, voicing contrasts are maintained only before sonorants. According to Steriade, this is the pattern found in several Indo-European languages, among them Lithuanian.

Lithuanian constitutes the most transparent counterexample to the prosodic account provided by Steriade. The argument runs as follows. There is agreement that Lithuanian medial clusters are heterosyllabic, regardless of the nature of the consonants, e.g. áuk.le, not *áu.kle. Distinctive voicing is preserved before sonorants but lost elsewhere, that is before obstruents and word-finally. For example, the opposition between áukle 'governness' and auglingas 'fruitful' and that between silpnas 'weak' and skobnis 'table' illustrate that stops may be voiced or voiceless before laterals and nasals. Word-finally obstruents are all voiceless, e.g. kàd [kat], and before another obstruent they assimilate in voicing, e.g. dèg-ti [kt] 'burn-INF'. In all these cases the (first) obstruent arguably appears in coda position, yet it may or may

not maintain voicing contrasts. We conclude that the behavior of voicing features does not depend on the syllabic position but on the nature of the following segment. The ranking *αvoice/__O, __# >> PRESERVE [voice] >> *αvoice/__R nicely and simply accounts for the Lithuanian pattern. I refer the reader to Steriade's paper for a discussion of similar and other cases.

**3.2.2. MARKEDNESS CONSTRAINTS**

The evidence presented in chapters 1 and 2 supports the hypothesis that the behavior of phonological elements is shaped by their perceptibility, and applies it to segment deletion and epenthesis. I propose that the principle of perceptual salience in (1) impacts the phonology through markedness constraints that miliate against segments that are not perceptually salient. (I restrict my attention to segments but the idea and its implementation could extend to other phonological elements.) These constraints obey the general format in (8):

(8)    GENERAL FORMAT OF PERCEPTIBILITY-BASED MARKEDNESS CONSTRAINTS:
       S — X       A segment S appears in a context X where it is perceptually salient.

Here I consider only cases where S is a consonant. I take vocalic transitions to be crucial in a consonant's perceptibility, and I assume that consonants are maximally salient in prevocalic position, reflecting the privileged status of CV sequences. The whole architecture to be developed below rests on these observations and on a corresponding family of constraints against non-prevocalic consonants (which are necessarily in a perceptually non-optimal position). I propose the following two basic constraints, which reflect the general part of generalization 1.[12] The double arrow "↔" is used throughout to refer to adjacency, the simple arrow "→" indicates precedence.[13]

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[12]These constraints were used independently by Fleischhacker (2000a,b), and the one in (9a) also by Steriade (1999d)

[13]We could also imagine a constraint C ← V "C is preceded by V", which would be posited if the preceding vowel provided better cues than the following one. This does not correspond to the general situation, but according to Steriade (1999a,c), retroflexion would be a relevant case, as she argues that it is better cued by a preceding vowel than by a following one. We might then need a constraint specific to retroflex consonants like [retroflex] ← V "a retroflex consonant is preceded by a vowel". But I do not deal at all with retroflex consonants in this dissertation.

(9)    BASIC CONSTRAINTS ENFORCING ADJACENCY TO VOWELS (*Generalization* 1):
       a.  C ↔ V          A consonant is adjacent to a vowel.
       b.  C → V          A consonant is followed by a vowel.

Not all consonants are equivalent with respect to the desirability to benefit from the cues associated with an adjacent or following vowel. I integrate this fact into the system by allowing the target of these constraints – C – to be specified for any factor that affects its perceptibility: those concerned with the consonant itself (classes of consonants) and those that depend on the context (neighboring segments, adjacent boundaries[14]). More specifically, the following arguments can be specified.

(10)   FACTORS AFFECTING CONSONANT PERCEPTIBILITY:
       a.  Class of consonants
           Ex: stops, strident fricatives, nasals, coronal stops, etc.
       b.  Similarity with adjacent segments, expressed in terms of agreement or contrast in some feature F
           Ex: agreement or contrast in place of articulation, continuancy, voicing, etc.
       c.  Presence of an adjacent boundary
           Ex: Followed by an Intonational Phrase boundary, preceded by a Prosodic Word boundary, etc.
       d.  (For stops) Nature of the following element (as it affects the audibility of the release burst)

To account for generalizations 2-6, I design the constraints in (11)-(15), which are specific instantiations of the constraints in (4):

(11)   CONSTRAINTS ENCODING THE SPECIAL STATUS OF STOPS (*Generalization* 2):
       a.  stop ↔ V              A stop is adjacent to a vowel.
       b.  stop → V              A stop is followed by a vowel.

(12)   CONSTRAINTS ENCODING THE ROLE OF THE ELEMENT FOLLOWING A STOP (*Generalization* 3):
       a.  stop(¬__ [+cont]) ↔ V        A stop that is not followed by a [+continuant] segment is adjacent to a vowel.
       b.  stop(¬__ [+cont]) → V        A stop that is not followed by a [+continuant] segment is followed by a vowel.

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[14]One could include the location of stress, which also affects salience.

(13)    CONSTRAINTS ENCODING THE ROLE OF SIMILARITY (*Generalization 4*):[15]
     a.   C(AGREE=F) $\leftrightarrow$ V      A consonant that agrees in some feature F with a neighboring segment is adjacent to a vowel.
     b.   C(AGREE=F) $\rightarrow$ V[16]      A consonant that agrees in some feature F with a neighboring segment is followed by a vowel.

(14)    CONSTRAINTS ENCODING THE ROLE OF BOUNDARIES (*Generalization 5*):
     a.   C|$_i$ $\leftrightarrow$ V      A consonant that is next to a boundary i is adjacent to a vowel.
     b.   C|i $\rightarrow$ V      A consonant that is next to a boundary i is followed by a vowel.

(15)    CONSTRAINTS ENCODING THE SPECIAL STATUS OF CORONAL STOPS (*Generalization 6*):
     C(cor stop) $\rightarrow$ V      A coronal stop is followed by a vowel.

In addition, for the constraints in (14) we must distinguish the preceding from the following boundaries, since they affect the phonotactics differently. This is not unexpected since, as we saw, left and right edges are not enhanced through the same mechanisms. (14) is decomposed in the two subcases below:

(16)    CONSTRAINTS ENCODING THE EFFECT OF THE FOLLOWING BOUNDARY:
     a.   C]$_i$ $\leftrightarrow$ V      A consonant that is followed by a boundary i is adjacent to a vowel.
     b.   C]i $\rightarrow$ V      A consonant that is followed by a boundary i is followed by a vowel.

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[15]The role of similarity with adjacent segments is encoded in the constraints in (13) in terms of featural agreement, but it could equally well be expressed in terms of featural contrast, as in the constraints below:
(i)      C(CONTRAST=F) $\leftrightarrow$ V      A consonant that contasts only in some feature F with a neihboring segment is adjacent to a vowel.
     C(CONTRAST=F) $\rightarrow$ V      A consonant that contasts only in some feature F with a neihboring segment is followed by a vowel.
I will stick to the agreement constraints in (13) in this dissertation, but I see no reason why one formulation should be prefered over the other. Agreement and contrast are really two faces of the same phenomenon. These markedness constraints being assumed to be built in the course of acquisition, it is reasonable to believe that language learners enjoy a relative degree of freedom in the formulation of these constraints.

[16]As we will see in the following chapter, this constraint is equivalent to an OCP-[F] constraint between adjacent segments.

(17)    CONSTRAINTS ENCODING THE EFFECT OF THE PRECEDING BOUNDARY:
     a.   $_i$[C $\leftrightarrow$ V      A consonant that is preceded by a boundary i is adjacent to a vowel.
     b.   $_i$[C $\rightarrow$ V      A consonant that is preceded by a boundary i is followed by a vowel.

These specifications can be freely combined to create more complex constraints. The constraints in (12) involve such a combination since they are specified for stops and the nature of the following element. The agreement and contrast specifications can also be combined with themselves, if different features are involved. Some examples follow:

(18)    EXAMPLES OF CONSTRAINTS COMBINING DIFFERENT ARGUMENTS:
     a.   stop]$_i$ $\leftrightarrow$ V
       A stop that is followed by a boundary i is adjacent to a vowel.
     b.   stop($\neg$__ [+cont] $\wedge$ AGREE=F) $\rightarrow$ V
       A stop that is not followed by a [+continuant] segment and that agrees in a feature F with a neighboring segment is followed by a vowel.
     c.   $_i$[C(AGREE=F $\wedge$ G) $\leftrightarrow$ V
       A consonant that is preceded by a boundary i and that agrees in the features F and G with a neighboring segment is adjacent to a vowel.

Within the family of constraints against non-prevocalic consonants, specific constraints may be inherently ranked. I assume that inherent ranking between two constraints is, as are the constraints themselves, based on perception and the principle of perceptual salience. I propose the condition in (19) for establishing such rankings:

(19)    DOMINANCE CONDITION:
     A constraint $\mathbb{C}_1$ dominates a constraint $\mathbb{C}_2$ if and only if the candidates that violate $\mathbb{C}_1$ are, everything else being equal, equally or less perceptible than the candidates that violate $\mathbb{C}_2$.

The effect of this constraint ranking is to have the less perceptible candidates eliminated before the more perceptible ones. This is what we expect from the grammar since, everything else being equal, a more perceptible candidate is always preferable to (more harmonic than) a less perceptible one. So a constraint that militates against less perceptible segments should be ranked higher than a constraint against more perceptible ones.

The ranking condition in (19) enables us in particular to establish the following dominance relation between the two constraints in (9):

(20)    DOMINANCE RELATION BETWEEN THE CONSTRAINTS IN (9):
        $C \leftrightarrow V \; >> \; C \rightarrow V$

This ranking, as it will become clear later, is crucial for the analyses to follow. It is derived in the following way. Consider the following strings of segments, where § represents a pause. The consonants with a letter subscript violate both $C \leftrightarrow V$ and $C \rightarrow V$; those with a number subscript violate only $C \rightarrow V$. No consonants may violate $C \leftrightarrow V$ without simultanously violating $C \rightarrow V$.

(21)    ...$VC_1C_dCV$...              ...$VC_2C_e$§              §$C_fCV$...

Everything else being equal, I assume that consonants that lack vocalic transitions are less perceptible than consonants that benefit from transitions from at least one vowel. The letter-subscripted consonants are therefore less perceptible than the number-subscripted ones. So the consonants that violate $C \leftrightarrow V$ are either equally or less perceptible than those that violate $C \rightarrow V$. This meets the conditions in (19) for establishing the dominance relation $C \leftrightarrow V >> C \rightarrow V$. This is the only possible ranking between the two constraints; the reverse order is excluded since it is not the case that the consonants that violate $C \rightarrow V$ are all equally or less perceptible than the consonants that violate $C \leftrightarrow V$. The ranking in (20) can be extended to all the constraints derived by specifying one or more of the arguments in (10): for all $C_j$, where $C_j$ is any specified consonant, the ranking $C_j \leftrightarrow V >> C_j \rightarrow V$ necessarily holds, e.g. stop$\leftrightarrow$V >> stop$\rightarrow$V, $C]_i \leftrightarrow V >> C]_i \rightarrow V$, etc.

The rankings in (22) can be established in the same way. They follow straightforwardly from the perceptual facts described in section 3.1: stops are less perceptible than other consonants in non-prevocalic position (22a); stops that are not followed by a [+cont] segment are less perceptible than other stops (22b); consonants that are more similar to (i.e. agree in some feature F with) an adjacent segment are less perceptible than consonants that are less similar (i.e. do not agree in the same feature F) (22c-d); consonants that are adjacent to a weaker boundary i are less perceptible than consonants that are adjacent to a stronger boundary j (22e). I note the absence of boundary with the symbol Ø. Consonants that are adjacent to no boundary are the least perceptible, which establishes the ranking in (22f).

(22)    INHERENT RANKINGS BETWEEN MARKEDNESS CONSTRAINTS:
        a.  stop $\rightarrow$ V >> C $\rightarrow$ V
            stop $\leftrightarrow$ V >> C $\leftrightarrow$ V
        b.  stop($\neg$__ [+cont]) $\rightarrow$ V >> stop $\rightarrow$ V
            stop($\neg$__ [+cont]) $\leftrightarrow$ V >> stop $\leftrightarrow$ V
        c.  C(AGREE=F) $\rightarrow$ V >> C $\rightarrow$ V
            C(AGREE=F) $\leftrightarrow$ V >> C $\leftrightarrow$ V
        d.  C(AGREE=F∧G) $\rightarrow$ V >> C(AGREE=F) $\rightarrow$ V ; C(AGREE=G) $\rightarrow$ V
            C(AGREE=F∧G) $\leftrightarrow$ V >> C(AGREE=F) $\leftrightarrow$ V ; C(AGREE=G) $\leftrightarrow$ V
        e.  $C]_i \rightarrow$ V >> $C]_j \rightarrow$ V        if i is a weaker boundary than j
            $C]_i \leftrightarrow$ V >> $C]_j \leftrightarrow$ V        if i is a weaker boundary than j
        f.  $C]_\varnothing \rightarrow$ V >> $C]_i \rightarrow$ V        if i ≠ Ø
            $C]_\varnothing \leftrightarrow$ V >> $C]_i \leftrightarrow$ V        if i ≠ Ø

This basically exhausts the rankings that will be needed in the analyses to come. Note that these ranked constraints all are in a subset relation to one another, e.g. stops are a subset of consonants; consonants that are adjacent to a boundary j are a subset of consonants that are adjacent to a lower boundary i (including no boundary). The constraints only differ in one dimension whose effect on perceptibility is considered clear. The rankings I use never involve multidimensional comparisons of perceptibility, for example comparing stops at a boundary j and non-stops at a lower boundary i, which contrast in two dimensions with opposite effects on perceptibility. Avoiding multidimensional perceptibility comparisons allows us to escape a lot of potential difficulties and controversies, in view of the complexity involved in such comparisons. See Flemming (1995) for a similar situation. But multidimensionality is certainly an issue that should be taken up in the future.

Before leaving this section, a final word about the Sonority Sequencing Principle, which was crucially involved in the case studies in chapters 1 and 2. The phonetic nature of sonority is not yet clearly understood, nor is its relation to perception and articulation (see Clements 1990 for discussion). I take it here to be independent from the Principle of Perceptual Salience. To account for its role in consonant deletion and vowel epenthesis, I simply propose the constraint in (23), which meets our needs:

(23)    SONORITY SEQUENCING PRINCIPLE (SSP):
        Sonority maxima correspond to sonority peaks.

### 3.2.3. FAITHFULNESS CONSTRAINTS

The markedness constraints against non-prevocalic consonants interact with faithfulness constraints to yield the attested patterns. Since I deal here only with epenthesis and deletion, I use the following two basic constraints (from McCarthy & Prince 1995):

(24)    BASIC FAITHFULNESS CONSTRAINTS:
   a.  MAX            Do not delete
   b.  DEP            Do not epenthesize

It has been noticed several times, however, that these general faithfulness constraints do not allow us to reduce the set of optimal candidates to the desired singleton (Lamontagne 1996; Steriade 1999d; Wilson 2000). The problem is easy to see. I illustrate it first with a hypothetical case of consonant deletion, and discuss epenthesis later. Suppose an input of the form $/VC_1C_2V/$ and a grammar G characterized by the two constraint rankings C→V >> MAX and DEP >> MAX. This grammar yields obligatory deletion of one of the two consonants, to ensure that all consonants in the output are followed by a vowel. But it cannot determine *which* consonant to delete. As illustrated in the tableau below, the outputs $[VC_1V]$ and $[VC_2V]$ are equivalent with respect to G. Here and in the rest of this dissertation I use thick lines between columns to indicate that the constraint at the left dominates that at the right, e.g. between DEP and MAX in (25). Thin lines between two constraints indicate ranking indeterminacy between them, e.g. between C→V and DEP.

(25)    FAILURE TO IDENTIFY THE CORRECT DELETION SITE:

| $/VC_1C_2V/$ | C → V | DEP | MAX |
|---|---|---|---|
| a.    $VC_1C_2V$ | *! | | |
| b.    $VC_1VC_2V$ | | *! | |
| c. → $VC_1V$ | | | * |
| d. → $VC_2V$ | | | * |

G then needs to be augmented to be able to pick between candidates c. and d. I propose that this is done by using context-sensitive faithfulness constraints, whose ranking is perceptually motivated and determined by considerations of relative perceptibility of constrasts. This corresponds to the partial adoption of Steriade's (1999b,d, 2000b, to appear) new approach to correspondence, based on a linguistic component called the P-map. Other proposals that are meant to solve this problem include Relativized Contiguity (Lamontagne 1996) and targeted constraints (Wilson 2000), which I will review in turn.

Lamontagne proposes that the choice between $VC_1V$ and $VC_2V$ is to be made by contiguity constraints which demand that any sequence of segments contiguous in the input/output be contiguous in the output/input. He defines two general types of contiguity constraints, called DOMAIN-CONTIGUITY (D-CONTIG) and JUNCTURE-CONTIGUITY (J-CONTIG), which evaluate contiguity between segments within a domain and across adjacent domains, respectively, where domains correspond to prosodic units like the syllable, the foot, the Prosodic word, etc. D-CONTIG penalizes the existence of segments that are contiguous within a constituent in the output, but are not contiguous in the input. J-CONTIG penalizes the existence of segments that are contiguous across a boundary in the output, but are not contiguous in the input. The ranking between these two constraints determines which consonant to delete or where to epenthesize.

Consider the same $/V_aC_1C_2V_b/$ input and the two possible outputs $[V_a.C_1V_b]$ and $[V_a.C_2V_b]$, syllabified as indicated by the dot. The $[V_a.C_1V_b]$ output violates D-CONTIG(syllable): $C_1$ and $V_b$ are contiguous within a syllable in the output, but they are not contiguous in the input. But the same output does not violate J-CONTIG(syllable), since $V_a$ and $C_1$, which are contiguous across a syllable boundary in the output, are also contiguous in the input. The candidate $[V_a.C_2V_b]$ is the mirror image of $[V_a.C_1V_b]$. It violates J-CONTIG(syllable) (since $V_a$ and $C_2$ are contiguous across a syllable boundary in the output but they are not contiguous in the input) but not D-CONTIG(syllable). Which of $[V_a.C_1V_b]$ and $[V_a.C_2V_b]$ turns out to be optimal depends on the language-specific ranking between J-CONTIG(syllable) and D-CONTIG(syllable). If D-CONTIG(syllable) dominates J-CONTIG(syllable), $[V_a.C_2V_b]$ wins out and it is the first consonant that deletes. Diola Fogny instantiates this ranking, e.g. /let-ku-jaw/ → [lekujaw] 'they won't go'. If J-CONTIG(syllable) outranks D-CONTIG(syllable), $[V_a.C_1V_b]$ is selected. As an example of this ranking, Lamontagne cites Wiyot (Teeter 1964), e.g. /pucarag+lolisw-/ → [pucaragorišw-] 'whistle a tune' (where /g/ corresponds to /ɣ/ in Teeter's transcription).

Lamontagne's solution works; the problem I see with it is that it considers the deletion of $C_1$ and $C_2$ equally likely. In fact they are not; Wilson (2000) and Steriade (1999b) note that it is typically the first consonant that deletes, as in Diola Fogny, and both relate this fact to the better cues associated with prevocalic consonants, hence their higher perceptibility and greater resistance (see section 3.1.1). Wilson claims that known exceptions to this pattern – that is deletion of the second (prevocalic) consonant – involve independent factors, in particular a preference for keeping stem

consonants over affixal ones, or less sonorous consonants (which form better onsets) over more sonorous ones. Turkish (Keyser & Clements 1983) is given as an illustration of morphologically-based deletion, Pāli (Hankamer & Aissen 1974) as one of sonority-based deletion.

As for Wiyot, the evidence it provides is unclear. Teeter (1964: 26) does suggest that illicit combinations of two consonants across morpheme boundaries are repaired by deletion of the second element. Supporting data, however, are scarce. Teeter cites one exception to his generalization: when /h/ is followed by a consonant with which it cannot combine, it is the /h/ that deletes. Interestingly, all but one of the examples I have found of deletion of the prevocalic consonant in /...VC+CV.../ also involve /h/ in /C+h/ sequences. One may wonder, then, whether it is not the deletion of the laryngeal consonant that is favored, irrespective of its position. Deletion of a prevocalic consonant other than /h/ was only found in the example cited above (/pucarag+lolisw-/ → [pucaragorišw-] 'whistle a tune'), on which I cannot comment.[17]

Granting the unconclusiveness of the Wiyot case, the theory should predict that, everything else being equal, it is the postvocalic consonant rather than the prevocalic one that deletes in a VCCV sequence. Both Wilson (2000) and Steriade (1999b,d, 2000b) accomplish this. Wilson derives this result by introducing a new type of markedness constraints, called targeted constraints, whose main novelty is to restrict the candidates that are being compared by these constraints to a set of forms that are considered similar enough, according to a similarity criterion. Similarity here is defined in terms of perceptual confusability. Formally, a targeted constraint $\rightarrow$C is defined in terms of a specific statement of absolute markedness and a similarity criterion. For any two candidates a and b, the targeted constraint $\rightarrow$C prefers a over b iff a is less marked than b according to the absolute markedness statement and a is considered sufficiently similar to b.

A more concrete example will make this system clearer. Take again our hypothetical $VC_1C_2V$ case and assume the targeted constraint $\rightarrow$NOWEAK-C, which militates against segmental root nodes in the output (the absolute markedness statement corresponds to *STRUC(Rt)). Wilson states that consonants in preconsonantal position are perceptually weak (on which we agree), that is they are difficult to distinguish from Ø. Prevocalic consonants, however, are associated with

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[17]There is a class of inalienable nouns that may appear to involve the deletion of a prevocalic consonant in possessed forms (pp. 80-81), e.g. *bápt* 'teeth' but *khápt* 'your teeth', containing a second person possessive prefix *kh-*. All the unpossessed forms of the words in this class, however, begin with /b.../, which is most probably not part of the base but also a prefix.

strong cues. The constraint $\rightarrow$NOWEAK-C only compares candidates that are perceptually comparable, i.e. $VC_1C_2V$ and $VC_2V$, but crucially not $VC_1C_2V$ and $VC_1V$. In this limited competition, $VC_2V$ fares better on *STRUC(Rt) and wins. The crucial consequence of the targeted constraint is to evacuate the candidate $VC_1V$, which is in the end what we aim at.

Wilson's proposal crucially relies on perceptual salience and auditory similarity, which are I believe the relevant factors. It is $C_1$ that deletes because it is perceptually weaker than $C_2$ (recall the comparison between consonants in CV and VC contexts in section 3.1.1). But my main concern about targeted constraints is the dichotomized split they impose between the comparable and non-comparable candidates. How are we to define and determine the levels of acceptable similarity, acknowledging the gradient nature of perceptibility? This issue has immediate empirical consequences. Take a more complex three-consonant cluster $VC_1C_2C_3V$. Under simplification, it is typically $C_2$ that deletes, which is the consonant that does not benefit from any vocalic transitions. $C_3$ is the perceptually strongest consonant (everything else being equal), $C_1$ being in an intermediate situation between $C_2$ and $C_3$. We may safely assume that $VC_1C_2C_3V$ and $VC_1C_3V$ are comparable under $\rightarrow$NOWEAK-C, and that $VC_1C_2V$ is excluded from the comparison. But what about $VC_2C_3V$? Should it be considered similar enough to $VC_1C_2C_3V$? The answer is no if we want $VC_1C_3V$ to end up as the only optimal candidate; because if we include $VC_2C_3V$ in the comparison, both $VC_1C_3V$ and $VC_2C_3V$ will fare equally. But is there a motivation for this exclusion, other than the desire to get the correct result?

Consider now a case where $C_2$ cannot delete for some independent reason; for example, it has to surface because of its morphological status. $C_1$ would then be more likely to delete than $C_3$. Unfortunately, I do not have a specific pattern at hand, but suppose that there exists a language in which $C_1$ deletes if the deletion of $C_2$ is ruled out by some independent higher-ranked constraint. Such a case does not seem to me to be at all implausible. If both $VC_2C_3V$ and $VC_1C_2V$ are excluded by the targeted constraint, we find again the initial problem and the grammar cannot choose between deleting $C_1$ and deleting $C_3$. In this language, the targeted constraint should consider the intermediate candidate $VC_2C_3V$ if we are to derive the correct output.

I do not believe that it is fatal for Wilson's proposal that the set of similar enough candidates is grammar-specific; indeed, this may be the expected situation. But I think that the dichotomy involved in the similarity criterion of targeted constraints is at odds with the inherent relativity of perceptibility. Rather than deciding whether or not a candidate is to be included in the evaluation of a

constraint, grammars should encode the relative likelihood that consonants in different positions delete. This can be done quite naturally in a framework such as Optimality Theory. Determining which consonant will ultimately be dropped then follows from interactions with other constraints.

This is precisely what Steriade's (1999b,d, 2000b, to appear) approach to faithfulness constraints achieves. Steriade proposes that faithfulness or correspondence constraints are projected from, and their ranking determined by, a grammatical component, called the P-map. The P-map is a set of statements about perceived distinctiveness differences between different contrasts in different contexts. For example, the P-map may tell us that the contrast between [t] and [d] is better perceived before a vowel than before a consonant (same contrast in different positions), or that the contrast between [t] and [n] is better perceived than the contrast between [t] and [d] word-finally (different contrasts in the same environment). The contrast and the context may covary and the P-map can also claim that the contrast between Ø and [ə] after a consonant word-finally is better perceived than the contrast between [t] and [d] after a vowel word-finally (examples from Steriade 2000b). These comparisons are derived from statements about the absolute distinctiveness or perceptibility of contrasts. Each contrast x-y/__K (contrast between x and y in context K) is associated with a specific distinctiveness index and projects a corresponding faithfulness constraint of the form CORRESP.(x-y/__K). If it can be determined from the P-map that a contrast x-y/__K is more perceptible than a contrast w-z/__Q, then for any correspondence constraint, CORRESP.(x-y/__K) dominates CORRESP.(w-z/__Q).

Let us go back to our $VC_1C_2V$ example again. We have determined that in this context $C_2$ is perceptually more salient than $C_1$ (everything else being equal). In other words, the contrast between C and Ø in the context C__V is more distinctive or perceptible than the contrast between C and Ø in the context V__C. Translated in terms of the correspondence constraint MAX-C, this comparison derives the ranking MAX-C/C__V >> MAX-C/V__C. This ranking determines that, everything else being equal, deletion of a postvocalic consonant is always favored over that of a prevocalic one. That is, $VC_1C_2V$ is reduced to $VC_2V$ and not $VC_1V$, as shown in the tableau. This is the result we intended to derive.

(26)    GETTING THE DELETION SITE WITH CONTEXT-SENSITIVE FAITHFULNESS:

| /$VC_1C_2V$/ | C → V | MAX-C/C__V | MAX-C/V__C |
|---|---|---|---|
| a.      $VC_1C_2V$ | * ! | | |
| b.      $VC_1V$ | | * ! | |
| c. → $VC_2V$ | | | * |

To account for the simplification of three-consonant clusters $VC_1C_2C_3V$, we need to extend the ranking of MAX-C constraints to include the constraint against deletion of interconsonantal consonants MAX-C/C__C. Such consonants are less perceptible than consonants that benefit from vocalic transitions. Again, the contrast between C and Ø in the context C__C is less distinctive than the contrast between Ø and a C that is adjacent to a vowel. Consequently, MAX-C/C__C is ranked lower than the constraints against deletion of pre- and post-vocalic consonants:

(27)    RANKING OF CONTEXT-SENSITIVE MAX CONSTRAINTS:
         MAX-C/C__V >> MAX-C/V__C >> MAX-C/C__C

This ranking ensures that if nothing prevents it, $C_2$ is the consonant that deletes in $VC_1C_2C_3V$ sequences. But it also follows from it that if deletion of $C_2$ is ruled out by some independent constraint, it is $C_1$ that deletes, not $C_3$ (provided the appropriate ranking of the markedness constraint that motivates deletion, say C↔V, above MAX-C/V__C). This situation is illustrated in the tableau below. Let us have a three consonant-cluster in the input and two unviolable constraints: C↔V demanding that every consonant be adjacent to a vowel, and $KEEPC_2$, which could be any constraint that prevents the deletion of $C_2$, presumably for morphological reasons. In a grammar without $KEEPC_2$, it is easy to see that the optimal candidate is $VC_1C_3V$, given the inherent and perceptually-motivated ranking of the MAX-C constraints. The addition of the high-ranked constraint $KEEPC_2$ rules out this candidate, and the winner automatically becomes $VC_2C_3V$.

(28)    DELETING THE LEAST PERCEPTIBLE CONSONANT POSSIBLE:

| /$VC_1C_2C_3V$/ | $KEEPC_2$ | C↔V | MAX-C/C__V | MAX-C/V__C | MAX-C/C__C |
|---|---|---|---|---|---|
| a. $VC_1C_2C_3V$ | | * ! | | | |
| b.    $VC_1C_3V$ | * ! | | | | * |
| c. → $VC_2C_3V$ | | | | * | |
| d.    $VC_1C_2V$ | | | * ! | | |

This approach to correspondence is perfectly coherent with the basic intuition behind faithfulness constraints: the idea that the input should be modified minimally.

The innovation here is to define what counts as minimal in terms of perceptual distinctiveness. The relative ranking of a faithfulness constraint correlates with the extent to which its violation would perceptually disrupt the input. The ranking in (27) follows from the fact that deleting an interconsonantal consonant has a smaller perceptual impact or is less disruptive than deleting a postvocalic consonant; likewise for postvocalic vs. prevocalic consonants. This approach, however, requires a change in the way we view inputs. Inputs have standardly been considered abstract unpronounceable entities. But if we evaluate faithfulness in terms of perceptual modification, we have to define inputs as elements that are, at least potentially, perceivable, that is, basically, as potential outputs. The consequences of this shift for phonology are not clear to me at this point. It is obvious that this issue deserves a more elaborate discussion, but I can only hope that it will be taken up in the future.

The reasoning that has led to the ranking in (27) can be extended to variables other than the vocalic context of consonants, and can motivate similar rankings. Given two constraints MAX-$C_1$ and MAX-$C_2$, MAX-$C_1$ >> MAX-$C_2$ iff the contrast between $C_2$ and Ø is less perceptible than the contrast between $C_1$ and Ø, in other words if $C_2$ itself is less perceptible (everything else being equal) than $C_1$. Section 3.1 identified a number of factors that increase or decrease the perceptibility of consonants. One of them was the presence of adjacent vowels, hence the ranking in (27). Other variables include the nature of the consonant (stops having weaker internal cues than other consonants), the continuancy value of the segment following stops, the amount of contrast with adjacent segments, and the presence of adjacent boundaries. These factors motivated the existence of markedness constraints against non-prevocalic consonants; they motivate faithfulness constraints in the same fashion. The constraints and the rankings that can be derived are given in (29), together with the generalization that they encode:

(29)    PERCEPTIBILIY-BASED FAITHFULNESS CONSTRAINTS:

     a. *Generalization 1:*
        MAX-C/__V >> MAX-C/V__ >> MAX-C
        MAX-C/__V     Do not delete a consonant that is followed by a vowel.
        MAX-C/V__     Do not delete a consonant that is preceded by a vowel.

     b. *Generalization 2:*
        MAX-C(-stop) >> MAX-C
        MAX-C(-stop)
        Do not delete a consonant that is not a stop.

     c. *Generalization 3:*
        MAX-stop/__[+cont] >> MAX-stop
        MAX-stop/__[+cont]
        Do not delete a stop that is followed by a [+continuant] segment.

     d. *Generalization 4:*
        MAX-C/CONTRAST=F >> MAX-C        (where F is any feature)
        MAX-C/CONTRAST=F
        Do not delete a consonant that contrasts in some feature F with an adjacent segment.

     e. *Generalization 5:*
        MAX-C$|_i$ >> MAX-C        (where i is any prosodic boundary)
        MAX-C$|_i$
        Do not delete a consonant that is adjacent to a prosodic boundary i.

Each ranking identifies a factor that affects the salience of consonants. In the general case consonants are endowed with enhancing factors and are correspondingly associated with specific higher-ranked MAX constraints, which dominate the general MAX-C. These include:
1) Consonants that are adjacent to a vowel (29a);
2) Consonants other than stops (29b). Note that I use +/-stop here in a purely descriptive fashion, and do not consider "stop" to be a phonological feature in the strict sense;[18]
3) Stops that are followed by a [+continuant] segment (29c);
4) Consonants that contrast in some feature F with an adjacent segment (29di);
5) Consonants that are adjacent to a prosodic boundary (29e).
The constraints in (29a) and (29b) will be illustrated (and supported) in the analysis of consonant deletion in Sranan in section 3.4 and Québec French in chapter 4. Those in (29c) will be used in the formal accounts developed in chapter 4.

The ranking of faithfulness constraints according to the principle of minimal perceptual disruption or modification of the input also applies to constraints other than MAX-C, in particular DEP-V. Epenthesis is indeed less disruptive in certain

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[18]Consonants other than stops could be more formally refered to as: "consonants that bear a positive "+" specification for some manner feature". Stops are [-sonorant], [-continuant], [-approximant], [-vocoid], i.e. they are negatively specified for all manner features, whereas all other consonants have at least one "+" specification for one or more of these features. This is the formulation I used in the original (official) version of this dissertation, but I adopt a more descriptive and straightforward formulation here.

contexts than in others, but the effect of the segmental and prosodic context does not appear to be as clear and systematic as with consonant deletion. In a /VC$_1$C$_2$V/ sequence, there is only one possible site for vowel epenthesis (if the motivation is to have every consonant adjacent to a vowel): [VC$_1$V̱C$_2$V]. Consider now a three-consonant sequence /VC$_1$C$_2$C$_3$V/, not tolerated on the surface. There are two possible outputs: [VC$_1$V̱C$_2$C$_3$V] and [VC$_1$C$_2$V̱C$_3$V]. Each of them is widely attested crosslinguistically, and the choice between them seems to be largely independent from perceptual factors, unlike consonant deletion. The famous contrast between different Arabic dialects (Broselow 1980, 1992; Selkirk 1981; Itô 1986, 1989; Lamontagne 1996; Zawaydeh 1997, among others) illustrates this variation in epenthesis sites: given an underlying three-consonant sequence, Cairene Arabic inserts an epenthetic [i] between the second and third consonants, whereas Iraqi inserts it between the first and second (30). In other languages, epenthesis systematically targets morphemic boundaries, e.g. French (chapter 2) and Chukchi (Kenstowicz 1994b).

(30)    Vowel epenthesis in Cairene and Iraqi Arabic:
   a.  Cairene        /ʔul+t+l+u/  →    [ʔultilu]       'I said to him'
   b.  Iraqi          /gil+t+l+a/  →    [gilitla]       'I said to her'

The factors underlying the distinction between Cairene and Iraqi are not entirely clear and I will not attempt to enlighten the issue. The contrast has been accounted for with directional syllabification (Itô 1986, 1989), reanalyzed in terms of alignment in Optimality-theoretic terms (Mester & Padgett 1993). Broselow (1992) proposed an alternative analysis, which links the location of epenthesis to the moraic or nonmoraic status of stray consonants, building on Selkirk's (1981) proposal based on the distinction between onsets and codas. I will simply adopt the alignment strategy when the issue arises.

This is not to say that perceptual factors are always irrelevant to the choice of the epenthesis site. Fleischhacker (2000a[19],b,c) conducted a crosslinguistic study of epenthesis in word-initial consonant clusters, in particular in loanword adaptation. I focus here only on two-consonant sequences. Some languages systematically insert the vowel in the same location, either before the two consonants (/CC/ → [V̱CC], e.g. Iraqi Arabic)  or inside the cluster (/CC/ → [CV̱C], e.g. Korean). But in an interesting subset of languages, e.g. Egyptian Arabic and Sinhalese (see

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[19]Fleischhacker (2000a) is a revised version of her M.A. thesis (2000c), which contains expanded discussion of the cross-linguistic data and results from an additional experiment, while omitting certain details of the experimental portion of the M.A. (Fleischhacker p.c.). I have had only access to this revised version.

Fleischhacker 2000a for additional languages), this choice is determined by the nature of the cluster: initial epenthesis (prothesis) with sibilant+stop (ST) clusters but medial epenthesis (anaptyxis) in stop+sonorant (TR) clusters.[20] No languages display the opposite pattern. What is also found are languages that use prothesis with ST clusters but leave TR clusters intact (e.g. Haitian, Catalan), and languages that allow initial ST clusters but break TR ones with anaptyxis (e.g. Lakhota, Central Yup'ik). What we observe, then, is a clear tendency to favor anaptyxis with stop+sonorant sequences and prothesis with sibilant+stop ones.

Fleischhacker's explanation for this contrast relies on perception and the idea of minimal disruption of the perceptual properties of the input: "the epenthesis site is chosen to maximize auditory similarity between the non-epenthesized input and the ouput" (2000a: 4); in other words, "epenthetic vowels are located exactly where they are least auditorily obtrusive" (p.14). Fleischhacker explains that the stop-sonorant juncture is acoustically similar to a stop-vowel one because both are characterized by a rapid increase in amplitude and onset of formant structure. The epenthetic vowel appears in a location corresponding to a vowel-like portion of the input, where we find no contrast in sonorancy. The sibilant-stop juncture lacks those vowel-like properties and anaptyxis there would constitute a major modification of the input. Prothesis is a better alternative, to the extent that "the output string corresponding to the input is not interrupted by an inserted element" (p.16). Fleischhacker provides experimental support for this perceptually-based hypothesis: əST was judged more similar to ST than SəT by a group of English speakers, while TəR was judged more similar to TR than əTR. She concludes that an inserted vowel is less perceptible, i.e. more confusable with Ø, in the context T__R, and more perceptible between a sibilant and a stop S__T. Word-initial epenthesis (before an obstruent) appears to form an intermediate case between S__T and T__R in terms of the auditory obstrusiveness of the process.[21] This hierarchy of perceptibility of the vowel is reflected in the following ranking of Dep-V constraints:

(31)    Ranking of context-sensitive Dep constraints:
        Dep-V/S__T >> Dep-V/#__ >> Dep-V/T__R

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[20]The behavior of sibilant+sonorant sequences is more variable and depends in particular on the sonority level of the sonorant; I omit these cases and refer the reader to Fleischhacker (2000a) for discussion.

[21]For the position of the word-initial context with respect to auditory similarity and the corresponding ranking in (31), I follow Fleischhacker (2000b). Fleischhacker (2000a) does not compare the context #__ with T__R and S__T, and does not use the coresponding constraint Dep-V/#__; she obtains the expected results by means of faithfulness constraints independent from the ranking in (31). For purposes of expository simplicity, I use the approach exposed in Fleischhacker (2000b).

Patterns with anaptyxis in TR clusters and prothesis in ST ones follow directly from this ranking, epenthesis being motivated by the high ranking of the markedness constraint C↔V. The Lakhota/Central Yup'ik case – anaptyxis in TR but ST allowed – derives straightforwardly from C↔V being ranked above Dep-V/T—R but below Dep-V/#—: only the least obtrusive instances of epenthesis are tolerated. The Haitian/Catalan case – prothesis in ST but TR allowed – appears more problematic, but could be understood in terms of the markedness of ST vs. TR sequences. TR clusters display a contrast in sonorancy absent from ST ones. I suggest that this makes the latter more marked, subject to the constraint C(Agree=[son])↔V (13), while TR clusters are only affected by the general and lower-ranked C↔V (22c). The ranking in (32) yields the Haitian/Catalan pattern. Prothesis in ST clusters follows from the ranking C(Agree=[son])↔V >> Dep-V/#— while the ranking Dep-V/T—R >> C↔V yields the absence of anaptyxis in TR sequences.

(32)    Ranking yielding prothesis in ST and no epenthesis in TR:
        C(Agree=[son]) ↔ V >> Dep-V/#— >> Dep-V/T—R >> C ↔ V

As for patterns with systematic anaptyxis or prothesis, Fleischhacker assumes that they arise from independent requirements, possibly a preference for consonants being followed (rather than preceded) by a vowel (systematic anaptyxis), or a Contiguity constraint (systematic prothesis).

We may briefly venture beyond initial epenthesis, to which Fleischhacker's study is restricted, and reflect on the observed tendency in several languages to epenthesize next to a sonorant but leave obstruent sequences intact. I cite three examples: Winnebago, Irish, and Upper Chehalis. In Winnebago (Miner 1979; Hale & White Eagle 1980), all sequences of an obstruent followed by a sonorant are broken by an epenthetic vowel, either a copy of the following vowel or a slight intrusive schwa. In the second case, the obstruent also becomes voiced. The copy type of epenthesis is known as Dorsey's Law, and is illustrated in the example in (33), from Hale & White Eagle (1980), which also shows the absence of epenthesis in the [kʃ] sequence.

(33)    Dorsey's Law in Winnebago:
        /ha+ra+ki+ʃ+ru+dˀik-ʃanạ/        →        [harakiʃurudˀikʃanạ]    'pull taut, 2ND'

Irish (Carnie 1994; Ní Chiosáin 1996, 1999; Green 1997) displays epenthesis between any sequence of a sonorant followed by a voiced obstruent (34a), while

clusters composed of a sonorant and a voiceless obstruent (34b) or two obstruents (34c) surface intact.

(34)    Vowel epenthesis in Irish:
        a.   /gorm/   →   [gorəm]        'blue'
        b.   /kork/   →   [kork]         'Cork (place name)'
        c.   /ʃaxt/   →   [ʃaxt]         'seven'

In Upper Chehalis (a Tsamosan Salish language), Rowicka (2000) proposes a rule of schwa epenthesis that applies specifically in sequences composed of a consonant and a sonorant (or a glottal stop), while the language tolerates long clusters of obstruents. The exact contexts for schwa epenthesis, however, are not clearly defined in the paper.

I believe these cases of asymmetry between clusters containing a sonorant and clusters composed only of obstruents can be understood in terms of the perceptual account of epenthesis proposed by Fleischhacker. Epenthesis applies only in clusters where it is not disruptive, leaving intact some marked clusters in which epenthesis would be too salient. This is a particularly welcome result as this asymmetry has remained puzzling. Alderete (1995) has analyzed the Winnebago case in terms of the Syllable Contact Law, which requires sonority to fall across syllable boundaries, but such an analysis cannot extend to the Irish and Upper Chehalis cases. In Irish, the fact that epenthesis is restricted to apply before voiced obstruents is consistent with the perceptual explanation since it is expected that vowel epenthesis will be less obtrusive in the context of voiced segments, which share with vowels the presence of low frequency energy associated with voicing. The fact that voicing favors epenthesis is also independently noticed in Fleischhacker (2000a: 15-16).

In this long section, I have argued for the adoption of perceptually-motivated faithfulness constraints, whose ranking reflects the degree of disruption of the auditory properties of the input. Deletion of less perceptible consonants or vowel epenthesis in a context where the vowel remains relatively non-salient leads to the violation of lower-ranked faithfulness constraints. This approach to correspondence constraints is obviously in keeping with what I have proposed for markedness constraints. In fact, one may be struck by the resemblance between the rankings of the Max-C constraints in (29) and those of the markedness constraints in (20) and (22), which are the mirror image of one other. Consider in this respect the rankings of Max-C and markedness constraints in (35), extracted from (20), (22), and (29).

The rankings in (35a-e) express the generalization that consonants that are less perceptible should be avoided more than consonants that are more perceptible. Those in (35f-j) encode the fact that the deletion of consonants that are more perceptible is less easily tolerated than the deletion of consonants that are less perceptible. The correspondence between the two series obviously follows from the fact that they are motivated by the same perceptual factors, and they both result in less perceptible consonants being less likely to surface than more perceptible ones.

(35)    EQUIVALENCE BETWEEN MARKEDNESS AND MAX-C CONSTRAINTS:

| Markedness constraints | MAX-C constraints |
|---|---|
| a. $C \leftrightarrow V \gg C \rightarrow V$ | f. MAX-C/C__V $\gg$ MAX-C/V__C $\gg$ MAX-C |
| *Common motivation:* prevocalic consonants are most perceptible, postvocalic ones are less perceptible, those that are not adjacent to any vowel are least perceptible | |
| b. stop $\rightarrow V \gg C \rightarrow V$<br>stop $\leftrightarrow V \gg C \leftrightarrow V$ | g. MAX-C(-stop) $\gg$ MAX-C |
| *Common motivation:* stops are less perceptible than other consonants (in non-prevocalic position) | |
| c. stop($\neg$__ [+cont]) $\rightarrow V \gg C \rightarrow V$<br>stop($\neg$__ [+cont]) $\leftrightarrow V \gg C \leftrightarrow V$ | h. MAX-stop/__[+cont] $\gg$ MAX-stop |
| *Common motivation:* stops that are followed by a [+continuant] segment are more perceptible than other stops | |
| d. C(AGREE=F) $\rightarrow V \gg C \rightarrow V$<br>C(AGREE=F) $\leftrightarrow V \gg C \leftrightarrow V$ | i. MAX-C/CONTRAST=F $\gg$ MAX-C |
| *Common motivation:* consonants that agree/contrast in some feature F with an adjacent segment are less/more perceptible than consonants that do not. | |
| e. $C|_i \rightarrow V \gg C|_j \rightarrow V$<br>$C|_i \leftrightarrow V \gg C|_j \leftrightarrow V$<br>if i is a weaker boundary than j | j. MAX-C$|_i \gg$ MAX-C |
| *Common motivation:* consonants that are adjacent to a prosodic boundary are more perceptible than consonants that are not. | |

One may worry about the redundancy present in this system. For example, is it necessary to integrate the effect of adjacent vowels (a and f), manner of articulation (b and g), the continuancy value of segments following stops (c and h), contrast/similarity (d and i), or the prosodic boundary (e and j) in both markedness and MAX-C constraints? I believe so, this system being both empirically adequate and maximally coherent. On the one hand, doing away with the context-specific MAX-C and DEP-V constraints yields an empirically inadequate system, which cannot

derive the correct outputs, because it cannot predict which consonant deletes and where epenthesis occurs. This is exactly the reason why the perceptual faithfulness constraints were proposed. On the other hand, failing to incorporate the perceptual motivations into the markedness constraints leads to a theory that seems at best incoherent. This conclusion arises when we consider the existence of multiple strategies to eliminate perceptually weak consonants. Consonant deletion and vowel epenthesis are frequent ones; metathesis is also a possible solution, as illustrated by the Lithuanian and Singapore English cases presented in the appendix to this chapter. In addition, vowel deletion may be blocked to satisfy perceptual requirements. All these processes are subject to the same factors (the presence of adjacent consonants, the perceptual weakness of stops, the strengthening effects of prosodic boundaries and contrast, etc.), and several of them may coexist in the same grammar (e.g. vowel deletion, vowel epenthesis, and consonant deletion in French; see chapters 2 and 4). Perceptually-motivated markedness constraints serve to provide a unified motivation for these different processes. Without such markedness constraints, the perceptual factors would have to be incorporated into each of the faithfulness constraints as well as the constraint motivating vowel deletion. We would then need our constraint ranking to encode, for example, the fact that epenthesis is more easily tolerated next to stops than next to other consonants. This appears inconsistent with the finding above that epenthesis is more likely next to a sonorant. The former generalization stems from the marked nature of stops lacking an adjacent vowel, the latter from the preference for less obtrusive epenthesis. Incorporating both of them into the ranking of DEP-V constraints would require it to meet potentially conflicting requirements: maximizing similarity between input and output and "saving" weak consonants. These requirements are better kept apart and dealt with by separate faithfulness and markedness constraints, as in the ranking in (32) above for the Haitian/Catalan pattern of initial epenthesis. The conclusion that both markedness and faithfulness constraints need to be context-specific is also reached by Kang (1998); see also Zoll (1998) who argues that positional markedness constraints are a necessary component of the grammar.

• Note on the P-map and the "Too-many-solutions problem"

Before closing this section, I should add a few comments concerning the scope of Steriade's proposal regarding perceptually-motivated constraints, and my position with respect to it. First, note that the main motivation behind Steriade's new approach to correspondence is not so much to solve the problem of which consonant to delete or where to insert a vowel in cluster simplification, although this is obviously a welcome result of it, but to develop a theory that better predicts the range of repair strategies that are available to a given phonotactic constraint. The

idea is easy to grasp: in current versions of OT, any phonotactic constraint can be met by the use of any possible repair strategy, depending on the ranking of the various faithfulness constraints. For example, suppose that a grammar disallows voiced obstruents word-finally. In principle, an input of the form /tab/ could be modified in a number of different ways to conform to this phonotactic requirement: devoicing [tap], nasalization [tam], approximantization [taw], epenthesis [tabə], deletion [ta], metathesis [bat], etc. Since the faithfulness constraints that prevent these processes are ranked freely, we expect to find languages that instantiate each of these solutions, depending on which of the faithfulness constraint is ranked lowest:

(36)   PREFERRED OUTPUT DEPENDING ON THE LOWEST-RANKED FAITHFULNESS CONSTRAINT:
       *Phonotactic constraint:* no word-final voiced obstruents
       *Input:* /tab/
       a.   [tap]          if the lowest faithfulness constraint is     IDENT-[voice]
       b.   [tam]                                                       IDENT-[nasal] / [son]
       c.   [taw]                                                       IDENT-[approximant]
       d.   [tabə]                                                      DEP-V
       e.   [ta]                                                        MAX-C
       f.   [bat]                                                       LINEARITY

Steriade's observation, however, is that only devoicing (36a) is attested as a response to a constraint against final voiced obstruents. This is completely unexpected in the current state of the theory and she refers to this situation as the Too-Many-Solutions Problem. Her answer to it is the P-map and the correspondence contraints its projects. The claim is that only devoicing is attested because it involves the smallest modification of the input. That is, the pair [tab]-[tap] is perceptually more similar than any other input-output pair in which the output conforms to the phonotactics: [tab]-[tam], [tab]-[tabə], [tab]-[ta], etc.

To show this, however, we have to compare the distinctiveness of contrasts that differ over multiple dimensions. For example, to conclude that the pair [tab]-[tap] is more similar than the pair [tab]-[tabə], we have to determine that the contrast between [b] and [p] in the context [a]__# is less distinctive than the contrast between Ø and [ə] in the context [b]__#. From this comparison we derive the following constraint ranking: DEP-V/C__# >> IDENT-[voice]/V__#.

This is clearly a more complex case than the one used to solve the consonant deletion problem above and which resulted in the ranking in (27), extended to those

in (29). These rankings are based on comparisons which involve the same contrast (C vs. Ø) in different contexts, or different contrasts (e.g. C vs. stops) in the same context. What we know about the acoustics and the perception of consonants allows us to establish with a reasonable degree of confidence a hierarchy of distinctiveness among different contexts or contrasts, when the other variable is held constant. The idea was not to compare different repair strategies, that is consonant deletion vs. something else, but rather the same process in different situations. In contrast, the voicing problem just described requires that we compare different contrasts in different contexts, a much more complicated task, the goal being to establish a hierarchy among distinct repair strategies.

We will not have to perform multidimensional comparisons in this dissertation, nor establish perceptually-motivated rankings between different types of faithfulness constraints. In fact, unlike in the voicing case, there is no single process designated as the optimal repair for phonotactic constraints against perceptually weak consonants: both consonant deletion and vowel epenthesis are widely attested, and it does not seem that DEP and MAX should be ranked in the way IDENT-voice and DEP were ranked above. Yet in her discussion of the various solutions to final voiced obstruents, Steriade (1999d) cites work by Fleischhacker (2000c), who compares consonant deletion and vowel epenthesis as strategies to avoid consonant clusters. In a psycholinguistic experiment, English speakers had to judge whether *hef* or *heftə* sounds more similar to a reference term *heft*. The form involving consonant deletion, *hef*, was rated as more similar to *heft* than the form with an epenthetic vowel *heftə*. This leads to the prediction that final clusters of this type should always be repaired by deletion rather than epenthesis, given the corresponding fixed ranking DEP-ə/C__# >> MAX-C/C__# that can be derived from the similarity judgments. This prediction is contradicted by numerous cases of epenthesis, from which I conclude that either Fleischhacker's result cannot be generalized or that auditory similarity is irrelevant in choosing between epenthesis and deletion in the avoidance of consonant clusters.[22] It remains to be seen to what extent this conclusion weakens Steriade's proposal for the voicing case. I leave this issue open and remain agnostic on whether and to what extent multidimensional comparisons between different repairs should be performed and determine the ranking between distinct faithfulness constraints. In the mean time, it should be clear that I adopt the idea of constraint ranking based on comparisons of distinctiveness of

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[22]In section 7 on cluster simplification, Steriade suggests that "the choice between V insertion and C deletion might remain free in resolving a size-of-cluster violation", on which I agree. But this claim can be contrasted with the results of Fleischhacker's study just presented, from which Steriade derives the ranking DEP(ə vs.Ø) >> MAX(C vs. Ø). This ranking could be taken to suggest that deletion should be favored over epenthesis in cluster reduction, and it is not clear to me why Steriade does not make this inference.

contrast only for a given repair, in order to determine what segment or portion of the string will be affected, and not to choose between repairs.

### 3.2.4. LIMITING THE ROLE OF PHONETIC GROUNDING

The perception-based approach developed here implies a view of the relationship between phonetics and phonology by which the former directly constrains the latter. This functionalist orientation in phonological theory has become prominent in recent years; Hayes (1999), for example, claims that "virtually all of segmental phonology (...) is driven by considerations of articulatory ease and perceptual distinctness". This view has not met with unanimity, and several researchers remain sceptical of the integration of functional, notably phonetic, factors in synchronic grammars (e.g. Ohala 1997; Hyman, to appear; Hale & Reiss 2000; Hansson 2000). These authors rather believe that phonetic determinism is only relevant in sound change and acquisition, but that synchronic grammars are formal systems which are subject to different principles. To the extent that synchronic processes are phonetically natural, this is considered a result of history and the acquisition process, not a property of phonological systems constrained by phonetic determinism.

Hyman (to appear) and Hale & Reiss (2000) in particular point to the existence of synchronic phenomena that are phonetically unnatural. Sound patterns interact with independent factors, such as borrowings, analogy, restructuring, and the result may be unnatural on articulatory or perceptual grounds. Yu (2000), for instance, describes a process of voicing in coda position found in Lezgian, which is quite unexpected from the point of view of universal phonetics. The existence of such processes leads to the inclusion of an arbitrary component in the grammar, that is one that is not functionally motivated. But once the necessity of an arbitrary grammatical component is acknowledged, conceptual economy argues for a view of grammar that comprises *only* arbitrary processes. As Hale & Reiss (2000) put it:

> [A grammar that has an arbitrary component and a nonarbitrary one] is empirically nondistinct from the theory we propose (...), which posits that *all* grammatical computations are arbitrary with respect to phonetic substance. (...) Since [we] must adopt a model which allows arbitrary phenomena (...), the addition to the theory of a special subcomponent to account for alleged "non-arbitrary" phenomena violates Occam's Razor. [their emphasis] (p. 161)

> Phonology is not and should not be grounded in phonetics since the facts which phonetic grounding is meant to explain can be derived without reference to phonology. Duplication of the principles of acoustics and acquisition constitutes a violation of Occam's razor and thus must be avoided. (p. 162)

As is often the case, I suggest that the solution lies neither in the all-phonetic approach nor in the all-arbitrary one. I see no reason why acknowledging the existence of phonetically unnatural processes should lead one to completely exclude phonetic grounding from phonology. Importantly, the conceptual economy argument brought by Hale & Reiss to evacuate phonetics from synchronic grammar seems to hold only if ones assumes, as they apparently do, that constraints are innate. I do not make such an assumption, but rather believe that constraints are built by language learners in the course of acquisition. What may be innate is only a constraint-building mechanism. Under this view, it seems difficult to consider formal phonology and acquisition to be two completely separate components of language, as is done by Hale & Reiss.

I argue that perception plays a direct role in the application of deletion and epenthesis processes. I also believe that grammars have to accomodate arbitrary phenomena. An obvious question, then, is: What is the division of labor between the arbitrary and functionally-motivated components of grammars, specifically phonology? I see two plausible options at this point, whose value will be determined by further research. First, notice that almost all the patterns examined in this dissertation and brought in support of the perceptual approach are variable ones. These include: consonant deletion in Hungarian, English, Icelandic, Catalan, Marais-Vendéen, and Québec French, as well as vowel epenthesis in French and Picard, and consonant deletion and vowel epenthesis in Basque (some of these cases will be examined in the following chapters). It could be that the role of functional motivations is synchronically limited to variable phenomena, in which direct comparisons between forms with different perceptual and articulatory properties can be made. The phonetic motivation, however, could be lost when processes become categorical. Under this view, final obstruent devoicing, for instance, could be considered an arbitrary process for kids learning German or Russian, but schwa insertion in French would be directly constrained by perception.[23]

Alternatively, phonetically-motivated constraints in phonology could be viewed as default ones, that is constraints that are more readily available to learners

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[23]Note that variable phenomena cannot be dismissed from synchronic grammars as change in progress. The French schwa has been variable for centuries.

in the process of grammar building. Arbitrary constraints would only emerge as a fall-back option when required by data that are not amenable to a functional account. It is not implausible to think that functional constraints would be constructed more easily than arbitrary ones since the former are grounded in and constrained by physical reality, whereas the latter are completely dependent on language-specific and process-specific data. Interestingly, this view of grammar can be tested psycholinguistically. We expect default elements to be acquired earlier than more marked ones. If the proposed split between the functional and arbitrary components of grammar is correct, we expect that children will generally master functionally-motivated processes before arbitrary ones. This remains to be investigated.

This discussion makes it clear that I am not claiming that all segmental phonology is phonetically-driven; I am only arguing for the existence of perceptually-based constraints in phonology. These constraints could have a more or less limited role in the grammar, depending on the correct division of labor between the arbitrary and non-arbitrary components. If functional constraints are limited to variable processes, their role in the grammar may be rather reduced; if they correspond to default options, much of phonoloy may be functionally-motivated, with the arbitrary part playing a subsidiary role.

**3.2.5. VARIATION IN OPTIMALITY THEORY**

As mentioned in the previous section, variation and frequency/likelihood are omnipresent in the processes investigated in this dissertation. This requires that we spend some time discussing the treatment of these aspects in phonological theory, particularly in Optimality Theory.

Variation has been a neglected area of phonological theory. Optional rules have been used to express non-categorical processes, but notions of frequency/likelihood or preference have been to a large extent relegated to the sociolinguistic domain. Yet a large portion of phonological variability is driven by the same factors that underlie categorical processes. I believe one of the major advantages of Optimality Theory over previous rule-based approaches is precisely its ability to model variation and derive hierarchies of frequency or gradient well-formedness.

Categorical phenomena are straightforwardly derived in OT by strict constraint ranking. Optionality is standardly handled by constraint ties (although these are excluded under the most constrained version of the theory), but this approach is too restrictive to account for all cases of variation. See e.g. Anttila (1997),

Côté (1999), and Auger (2000) for patterns that cannot be accounted for with tied constraints. A more powerful solution becomes available if we adopt Anttila's (1997) view of grammars as partial orders.[24] This approach abandons the assumption that all constraints are ranked (possibly tied) with respect to all others, and allows constraint rankings to remain underdetermined. A grammar may then be compatible with many different full or total rankings. These distinct rankings may, in turn, yield different outputs (for a given input). This is how variation (and optionality) is generated by the system.[25]

An additional assumption of Anttila is that frequency of use or the relative well-formedness of a given output should reflect the probability that it be generated by the grammar. This probability corresponds to the proportion of the possible rankings that yield this output. The following abstract example illustrates the mechanism. Suppose three constraints A, B, C, and a grammar consisting in the unique ranking A >> B. Three possible total orders of the constraints A, B, C are compatible with this grammar: A>>B>>C, A>>C>>B, and C>>A>>B. Suppose that for some input I the first ranking yields an output $O_1$, and the last two a different output $O_2$. This grammar then predicts variation / optionality between $O_1$ and $O_2$. In addition, it is expected that $O_1$, which is generated by one ranking out of three, will surface one third of the time, while $O_2$ will be used two thirds of the time.

I adopt Anttila's view of grammars as partial orders, as well as the relation between the frequency/likelihood of a form and the probability that it be selected by the constraint ranking. This relation, however, will not be interpreted in a strict fashion. That is, I will not expect these probabilities to be equal to actual frequencies of use, but only to reflect hierarchies of frequency or likelihood. If an output $O_2$ is generated by more rankings than an output $O_1$, I will not go much further than the prediction that $O_2$ is prefered to, or more likely than, $O_1$. The reasons for this loosening are twofold. First, in most cases I do not know the actual frequencies of use, which makes it impossible to test the stricter version of Anttila's theory. Second, actual frequencies are usually influenced by non-grammatical factors, which lead to deviations with respect to what is expected from the constraint system alone. I expect, however, that the order of preference of the forms is preserved.

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[24]Reynolds's (1994) floating constraints can be viewed as a sub-case of Anttila's partial orders.

[25]See Boersma (1998), Boersma & Hayes (1999), and Hayes (2000) for different approaches to variation in Optimality Theory, which I will not consider here.

## 3.3. APPLICATIONS

### 3.3.1. LENAKEL VOWEL EPENTHESIS

Vowel epenthesis in Lenakel is a good example to provide a first illustration of the functioning of the constraint system I propose. It specifically highlights the role of the markedness constraints. This process displays several of the factors identified as relevant – contrast, edge effects, adjacent vowels – and also shows a certain amount of variation. Yet the pattern is relatively simple and immune from independent intricacies.

The Lenakel epenthesis pattern can be described as follows (Lynch 1978; Blevins 1995; Kager 1999). An epenthetic vowel [ɨ] or [ə], depending on the preceding consonant, is automatically inserted in sequences of two consonants word-initially (37a-b) and finally (37c-d), and in clusters of three consonants word-internally (37e-f). The epenthetic vowel (underlined in the examples below) is inserted between the second and third consonant word-internally, and between the two consonants at word edges.[26]

(37)    OBLIGATORY VOWEL EPENTHESIS IN LENAKEL:
   a.   /t-n-ep-kɨn/    →    [tɨnébgən] - [dɨnébgən]    'you will eat it'
   b.   /t-r-ep-ol/     →    [tɨrébɔl]                  'he will then do it'
   c.   /r-ɨm-ign/      →    [rɨmə́ŋən]                  'he was afraid'
   d.   /n-əm-əpk/      →    [nɨmə́bək<sup>h</sup>]      'you (sg.) took it'
   e.   /ɨs-ɨt-pn-aan/  →    [əsɨdbənán]                'don't go up there'
   f.   /k-ar-pkom/     →    [karbə́gɔm]                 'they are heavy'

There is one exception to this pattern: glide+consonant sequences are tolerated word-finally:[27]

(38)    NO EPENTHESIS IN /G+C/ CLUSTERS WORD-FINALLY:
   a.   /pwapwauk/   →    [p<sup>w</sup>ɒb<sup>w</sup>ɒ́wk<sup>h</sup>]    'butterfly'
   b.   /aik/        →    [ajk<sup>h</sup>]                               'to swim'

In addition to the obligatory cases of epenthesis in (37), [ɨ]/[ə] is optionally inserted between any two consonants word-internally (39).[28] Insertion becomes obligatory, however, between two identical consonants across a morpheme-boundary (40).[29]

(39)    OPTIONAL EPENTHESIS IN INTERNAL /CC/ CLUSTERS:
   a.   /r-am-alfa/    →    [ramálfa] / [ramálɨfa]     'he is lazy'
   b.   /nimr-n/       →    [nímrɨn] / [nímərɨn]        'his eyes'

(40)    OBLIGATORY EPENTHESIS BETWEEN IDENTICAL CONSONANTS:
   a.   /i-ak-kɨn/     →    [yagə́gən]                  'I eat it'
   b.   /t-r-rai/      →    [tɨrɨray] / [dɨrɨray]       'he will write'

I analyze these facts in the following way. Consonants in Lenakel must surface with an adjacent vowel. This follows from a high-ranked general C↔V constraint. This constraint applies exceptionlessly word-internally and word-initially. However, it is relaxed for word-final consonants that are preceded by a glide. I interpret the latter condition as a requirement that the consonant contrasts in the feature [vocoid] with an adjacent segment. Consonants that agree in this feature

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[26] I adapt Lynch's (1978) transcription in the following way, in conformity with the IPA: [y] is replaced by [j]; [řʼ] is described as a flap and is replaced by [r]; [v] is described as a high central glide noted [ɨ] and this is the symbol I adopt.

[27] In fact, Lynch (1978: 15) describes this exception as follows: "when two consonants come together at the beginning or the end of a word, [ɨ] is inserted between them provided that neither is a glide". This characterization is met in principle in four different cases, the combinations C+G or G+C word-initially or word-finally. In fact I have found on the surface only the word-final G+C combination, illustrated in (38). Some combinations were not found in the data provided, especially initial G+C clusters. Interestingly, Bell & Hooper (1978: 11) claim that these are unattested crosslinguistically. Others merged into a single consonant by independent processes which I disregard here: glides becoming secondary articulations (i) or /h/ deleting while devoicing the adjacent consonant (ii). Note that Lynch includes /h/ in the set of underlying

glides, along with /w/ and /ɨ/; [j] is assumed to only surface as a reflex of /i/ in certain positions. In the case of /C+ɨ/, normal epenthesis applies, contrary to Lynch's generalization (iii).
(i)     /amnuumw/    →    [amnúm<sup>w</sup>]             'to drink'
        /t-i-is-ɨa-aan/  →    [tʼɛsɨeán] / [dʼɛsɨeán]   'I won't come'
(ii)    /rho/        →    [ɾó]                          'he hit it'
        /r-am-awh/   →    [ramáw̥]                      'she is weaving'
(iii)   /m-ɨin/      →    [mə̀ɨin]                       'and-go'
        /r-ɨa/       →    [rɨ̀ɨa]                        '3s-come'
Even if glide-containing sequences other than final G+C sequences turned out to be attested, it would not be a problem for the analysis sketched here.
[28] As long as the first consonant is not a glide and the following vowel is unstressed. I leave these additional conditions aside for the purposes of this illustration.
[29] When both consonants are coronals deletion of the first consonant occurs rather than epenthesis. Certain verbal prefixes, however, like /t/ and /r/ in (40b), cannot delete. When they are followed by an identical consonant, like the /r/ in the same example, then the general epenthesis rule applies. I leave a unified analysis of coronal deletion and vowel epenthesis for future research.

with their neighboring consonants invariably trigger epenthesis.[30] To account for these generalizations I design the following markedness constraints:

(41)  RELEVANT MARKEDNESS CONSTRAINTS:
  a.  C|ø ↔ V
      A PW-internal consonant (which is adjacent to no prosodic boundary) is adjacent to a vowel.
  b.  $_{PW}$[C ↔ V
      A consonant that is preceded by a PW boundary is adjacent to a vowel.
  c.  C]$_{PW}$ (AGREE=[vocoid]) ↔ V
      A consonant that is followed by a PW boundary and that agrees in [vocoid] with a neighboring segment is adjacent to a vowel.
  d.  C]$_{PW}$ ↔ V
      A consonant that is followed by a PW boundary is adjacent to a vowel.

By the dominance condition in (19), we can establish the inherent rankings in (42) between these constraints; the reader may also refer to the rankings in (22).

(42)  INHERENT RANKINGS BETWEEN THE MARKEDNESS CONSTRAINTS IN (41):
  a.  C|ø ↔ V >> $_{PW}$[C ↔ V
  b.  C|ø ↔ V >> C]$_{PW}$ ↔ V
  c.  C]$_{PW}$ (AGREE=[vocoid]) ↔ V >> C]$_{PW}$ ↔ V

Our task is now to rank DEP-V within this web of markedness constraints. The three constraints in (41a-c) are unviolated in the language and must dominate all constraints against vowel epenthesis. But DEP-V outranks C]$_{PW}$↔V, since epenthesis does not apply word-finally in the clusters that are not subject to the higher-ranked C]$_{PW}$(AGREE=[vocoid])↔V. This mini-grammar is given in graphic form in (43) and illustrated in the tableau in (44), with examples from (37) and (38). In this and all following graphics thick lines are used to indicate language-specific rankings determined on the basis of the available data, whereas thin lines indicate fixed inherent rankings.

The issue of the site of epenthesis obviously arises here. In internal three-consonant clusters, the vowel is inserted between the second and the third consonant, while it always occurs between the two consonants at edges. I disregard this issue in this first step and consider only the candidates with the correct

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placement of the epenthetic vowel. This problem will be addressed below. Finally, in /aik/, the last example in the tableau, I assume that the faithful candidate [aik] is excluded by a constraint against hiatus, which must at least dominate C]$_{PW}$↔V. I disregard the rules of alternation between high vowels and glides.

(43)  PARTIAL GRAMMAR OF LENAKEL I:
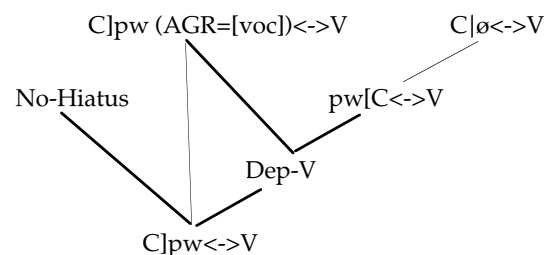


(44)  EPENTHESIS AND NON-EPENTHESIS IN LENAKEL:

| a. /t-r-ep-ol/ | NO-HIATUS | C]$_{PW}$ (AGR=[voc])↔V | C|ø↔V | $_{PW}$[C↔V | DEP-V | C]$_{PW}$ ↔ V |
|---|---|---|---|---|---|---|
| → tɨrɛbɔl | | | | | * | |
| trɛbɔl | | | | (t) ! | | |
| b. /n-əm-əpk/ | | | | | | |
| → nɨmábə̠kʰ | | | | | * | |
| nɨmápkʰ | | (kʰ) ! | | | | * |
| c./k-arp-kom/ | | | | | | |
| → kɑrbə́gɔm | | | | | * | |
| kɑrbgɔm | | | (b) ! | | | |
| d. /aik/ | | | | | | |
| ajVkʰ | | | | | * ! | |
| → ajkʰ | | | | | | * |
| aikʰ | * ! | | | | | |

In (44a) the faithful candidate [trɛbɔl] (disregarding vowel quality and intervocalic voicing) violates $_{PW}$[C↔V, which requires every word-initial consonant to be adjacent to a vowel. The epenthesized candiate [tɨrɛbɔl] violates DEP-V and is the winning output since DEP-V is ranked lower than $_{PW}$[C↔V. The situation in (44c) is similar, except that the markedness constraint violated by the faithful candidate is C|ø↔V rather than $_{PW}$[C↔V. (44b,d) contain underlying word-final two-consonant clusters. In (b) vowel insertion applies, in (d) it does not. The difference between

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[30]I assume that the final consonant is a non-glide. If glide+glide sequences are tolerated as well, the generalization would be that it is agreement in [-vocoid] specifically rather than [vocoid] that systematically triggers epenthesis.

these two cases lies in the nature of the cluster. The two segments in the sequence [pkʰ] (44b) share the same value for the feature [vocoid]. The final [kʰ] agrees in [vocoid] with the preceding consonant and is not adjacent to a vowel, in violation of the higher-ranked constraint C]$_{PW}$ (AGREE=[vocoid])↔V, which dominates DEP-V. Unlike [pkʰ], the sequence [jkʰ] (44d) displays a contrast in the feature [vocoid] and only yields a violation of the general lower-ranked constraint C]$_{PW}$↔V.

Let us now look at word-internal two-consonant sequences. We have seen that epenthesis in such medial clusters is optional in the general case, but obligatory between two identical consonants. The relevant constraints to deal with these facts are given in (45), and the derivable inherent rankings that involve them in (46).

(45)   ADDITIONAL MARKEDNESS CONSTRAINTS:
   a.   C|ø (AGREE=∀F) → V
       A word-internal consonant (that is next to no prosodic boundary) and that agrees in all features with an adjacent segment is followed by a vowel.
   b.   C|ø → V
       A word-internal consonant (that is next to no prosodic boundary) is followed by a vowel.

(46)   ADDITIONAL INHERENT RANKINGS:
   a.   C|ø (AGREE=∀F) → V >> C|ø → V
   b.   C|ø ↔ V >> C|ø → V

C|ø (AGREE=∀F)→V is violated in cases of two identical consonants word-internally. This constraint is undominated in Lenakel and forces epenthesis. The ranking between DEP-V and the lower-ranked C|ø→V remains undetermined, since we find variation between forms that violate C|ø→V ([...VCCV...]) and forms that violate DEP-V ([...VCVCV...]). This is illustrated in the tableau below with forms from (39) and (40). The mini-grammar in (43) is augmented as in (48).

(47)   EPENTHESIS AND NON-EPENTHESIS IN WORD-INTERNAL CC CLUSTERS:

| a. /r-am-alfa/ | C|ø↔V | C|ø(AGR=∀F)→V | DEP-V | C|ø→V |
|---|---|---|---|---|
| → ɾamálɨfa |  |  | * |  |
| → ɾamálfa |  |  |  | (l) |
| b. /i-ak-kɨn/ |  |  |  |  |
| → yaɡə́ɡən |  |  | * |  |
| yaɡɡən |  | (g) ! |  | * |

(48) PARTIAL GRAMMAR OF LENAKEL II:
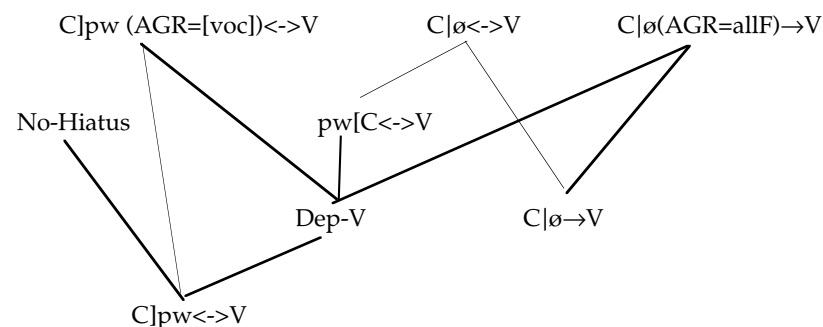


Let us now consider the issue of the site of epenthesis. I assume that the word-internal placement of epenthesis between the second and third consonants in three-consonant clusters is due to an alignment constraint requiring every consonant to align with the left edge of the prosodic word (49a), which dominates the corresponding constraint favoring alignment to the right (49b). These constraints are evaluated gradiently in terms of the number of segments that intervene between a consonant and the edge.

(49)   ALIGNMENT CONSTRAINTS DETERMINING THE LOCUS OF EPENTHESIS:
   a.   ALIGN-L (C,PW):   A consonant aligns with the left edge of a PW.
   b.   ALIGN-R (C,PW):   A consonant aligns with the right edge of a PW.
   c.   ALIGN-L (C,PW) >> ALIGN-R (C,PW)

(50)   DETERMINING THE LOCUS OF EPENTHESIS WORD-INTERNALLY:

| /k-ar-pkom/ | C|ø↔V | DEP-V | ALIGN-L (C,PW) | ALIGN-R (C,PW) |
|---|---|---|---|---|
| → karbáɡom |  | * | 0+2+3+5+7=17 | 0+2+4+5+7=18 |
| karábɡom |  | * | 0+2+4+5+7=18 ! | 0+2+3+5+7=17 |
| karbɡom | * ! |  | 0+2+3+4+6=15 | 0+2+3+4+6=15 |

At word edges epenthesis is always medial. Medial epenthesis (i.e. between the two consonants) is correctly predicted by the alignment constraints word-initially, but not word-finally, where we rather expect final epenthesis. Given an initial #CC sequence, left-alignment is better achieved in #CVC than in #VCC, which is what we find in Lenakel. The opposite holds with final CC# inputs: CCV# satisfies left-alignment better than CVC#. Yet it is the latter output that surfaces in Lenakel. As discussed in Blevins (1995), this is a problem for the directionality approach to the location of epenthesis, which carries over to the alignment one. This pattern – medial

epenthesis at both edges, irrespective of the prefered site word-internally – is not exceptional and is also found for example in Chukchi.

A somewhat unexpected but welcome result of the system of markedness constraints we have developed is that they automatically derive the Lenakel/Chukchi pattern of epenthesis in edge clusters, without the need for additional constraints. This follows from the observation, encoded in the ranking, that consonants are more easily tolerated at edges than domain-medially, everything else being equal. Epenthesis takes advantage of this and preferably applies in a way that puts the consonants at an edge rather than medially. The mini-grammar in (48), with the constraint C|ø→V playing the crucial role, yields the desired result, as shown in the tableau below, which concludes our first case study.

(51)      DETERMINING THE LOCUS OF EPENTHESIS AT WORD EDGES:

| a. /t-r-ep-ol/ | C]$_{PW}$ (AGR=[voc])↔V | C|ø↔V | $_{PW}$[C↔V | DEP-V | C|ø→V |
|---|---|---|---|---|---|
| → tirɛbɔl | | | | * | |
| itrɛbɔl | | | | * | (t) ! |
| trɛbɔl | | | (t) ! | | |
| b. /n-əm-əpk/ | | | | | |
| → nimə́bakʰ | | | | * | |
| nimə́bkə | | | | * | (b) ! |
| nimə́bkʰ | (kʰ) ! | | | | |

**3.3.2. SRANAN CONSONANT DELETION**

Alber & Plag (1999) discuss vowel deletion and consonant epenthesis in the formation of Sranan, an English-based creole language spoken in Surinam. Consonant clusters in the source language were extensively simplified in Sranan, usually by deletion, except word-finally, were we often find vowel epenthesis (paragoge). I am interested here in word-internal consonant deletion. It applies quite systematically to sequences of two consonants composed of obstruents and nasals. Liquids that are not intervocalic are subject to more varied and partly unpredictable processes: deletion, metathesis with an adjacent consonant or vowel, epenthesis, preservation. I focus here on clusters that do not involve liquids. Consider the data in (52) to (54).

(52)      SRANAN ADAPTATIONS OF STOP+FRICATIVE AND STOP+NASAL CLUSTERS:

|     | *English word* | *Sranan adaptation* |
|---|---|---|
| a. | cur<u>ts</u>ey | ko<u>s</u>i |
| b. | goo<u>dm</u>orrow | ku<u>m</u>ara |
| c. | goo<u>dn</u>ight | ku<u>n</u>eti |

(53)      SRANAN ADAPTATIONS OF FRICATIVE+STOP AND NASAL+STOP CLUSTERS:

| a. | ma<u>st</u>er | ma<u>sr</u>a, ma<u>s</u>era |
|---|---|---|
| b. | na<u>st</u>y | na<u>s</u>i |
| c. | si<u>st</u>er | si<u>s</u>a |
| d. | so<u>ft</u>ly | sa<u>f</u>ri |
| e. | re<u>memb</u>er | me<u>mr</u>e, memere |
| f. | so<u>meth</u>ing [mθ] | sa<u>n</u>i |

(54)      SRANAN ADAPTATIONS OF STOP+STOP CLUSTERS:

| a. | do<u>ct</u>or | da<u>t</u>ra |
|---|---|---|
| b. | si<u>t d</u>own | si<u>d</u>on |

In (52) we have English forms containing stop+fricative (a) and stop+nasal (b-c) clusters. In all cases only the second consonant is retained in Sranan. (53) shows examples of fricative+stop (a-d) and nasal+stop (e-f) sequences. Here it is the first consonant that shows up in the adapted form. The generalization is that stops preferentially delete over non-stops. It has been noticed in the discussion of faithfulness constraints, however, that in VCCV sequences, it is typically the first consonant that deletes. This generalization can be observed in clusters composed of two stops, in which case it is the second stop that is retained (54). This deletion pattern shows that the tendency to delete the first consonant in an intervocalic two-consonant cluster can be overridden by conflicting factors, here the stop or non-stop nature of the consonants.[31]

Alber & Plag do not extract these generalizations from the data. They notice variation in the position of the deleted consonant, but cannot account for it and simply leave the issue open. This pattern, however, receives a natural and simple

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[31]I suspect that the position of stress is relevant in the data in (52)-(54), but the data in the paper do not allow us to test this hypothesis. It could be that retention of the postvocalic rather than the prevocalic consonant occurs only in the context v́ccv̌, where the stable postvocalic consonant is adjacent to a stressed vowel, while the deleted stop is followed by an unstressed one. Adding the effect of stress to the analysis would not be problematic. The cues present in the transition to or from a stressed vowel are better than those to or from an unstressed one, since stressed vowels are generally associated with higher amplitude. This contrast could be easily integrated into our markedness and faithfulness constraints.

explanation in the framework developed here. The distinctions in (52)-(54) follow straightforwardly from the perceptually-motivated faithfulness constraints in (29a-b), repeated below. The deletion of postvocalic consonants is prefered over that of prevocalic ones, due to the better cues present in the CV transition. The deletion of stops is also more likely than that of non-stops because of the weakness of their internal cues.

(29)    RELEVANT FAITHFULNESS CONSTRAINTS IN SRANAN:
        a.  MAX-C/__V >> MAX-C/V__ >> MAX-C
        MAX-C/__V      Do not delete a consonant that is followed by a vowel.
        MAX-C/V__      Do not delete a consonant that is preceded by a vowel.
        b.  MAX-C(-stop) >> MAX-C
        MAX-C(-stop)   Do not delete a consonant that is not a stop.

By assuming the simple ranking in (55), we derive the data in (52)-(54), as shown in the tableau in (56). This ranking interacts with the constraint C→V, which is taken to motivate medial consonant deletion in Sranan. To account for the data in (52)-(54) C→V must at least dominate MAX-C/__V.

(55)    RANKING BETWEEN THE FAITHFULNESS CONSTRAINTS:
        MAX-C(-stop) >> MAX-C/__V >> MAX-C/V__

(56)    CONSONANT DELETION IN SRANAN:

| a. Eng. *goodnight* | C→V | MAX-C(-stop) | MAX-C/__V | MAX-C/V__ |
|---|---|---|---|---|
| kudneti | (d) ! | | | |
| → kuneti | | | * | |
| kudeti | | * ! | | * |
| b. Eng. *sister* | | | | |
| sista | (s) ! | | | |
| → sisa | | | * | |
| sita | | * ! | | * |
| c. Eng. *sit down* | | | | |
| sitdon | (t) ! | | | |
| → sidon | | | | * |
| siton | | | * ! | |

In all these examples the faithful output (in terms of the size of number of consonants, irrespective of other phonological processes) violates C→V and one of the consonants deletes. When the cluster contains a stop and a non-stop (56a-b), the

stop deletes, whether it appears in cluster-initial or cluster-final position, due to the high-ranking of MAX-C(-stop), which prohibits the deletion of non-stops. In clusters composed of two stops (56c), the first one is dropped since the constraint against the deletion of prevocalic consonants MAX-C/__V dominates that against the deletion of postvocalic ones MAX-C/V__.

### 3.4. CONCLUSIONS

In this chapter I have introduced the theoretical apparatus designed to account for the empirical generalizations presented in chapters 1 and 2 concerning deletion and epenthesis. The constraint system developed in section 3.2 rests on the perceptual motivations that underlie these generalizations, as explained in section 3.1. Both faithfulness and markedness constraints are taken to encode the notion of perceptibility and the desirability for segments to be perceptible. Faithfulness constraints ensure that consonant deletion targets the auditorily weakest consonants, and vowel insertion maximizes auditory similarity between input and output. Markedness constraints establish a correlation between the degree of perceptibility of consonants and their relative markedness. This theoretical orientation raises the more general issue of the role of perception, phonetic grounding, and other functional motivations in phonology, and I have argued for a mixed view of grammars as comprising both functionally-motivated and arbitrary processes, although the exact domains of these two components remain to be identified. Additionally, the treatment of variation in Optimality Theory, seen as a major advantage of this theoretical approach, has been addressed, as most patterns analyzed in the remainder of this dissertation are variable ones. Finally the constraint system was illustrated in the analysis of two simple cases of consonant deletion in Sranan and vowel epenthesis in Lenakel, which highlight the role of perceptually-motivated faithfulness and markedness constraints, respectively. The functioning of the constraint system will be more fully appreciated in the following two chapters, which expand on the role of contrast and edge effects in deletion and epenthesis.

**APPENDIX:**

**ADDITIONAL PATTERNS SHOWING THE SPECIAL STATUS OF STOPS**

I provide here additional patterns that exclusively or more specifically target stops. I present these patterns to further illustrate the special status of these consonants and their increased vulnerability in the absence of adjacent vowels. But I will not refer to them in the rest of the dissertation. Other cases are also described or mentioned in Steriade (1999d, to appear), among them Colloquial Latin (Niedermann 1953) and Dihovo Macedonian (Groen 1977).

There is one case of consonant deletion (Farsi) and, more interestingly, two cases of metathesis. Metathesis has not been mentioned as a possible repair strategy for complex consonant clusters. It is indeed marginal in comparison with deletion and epenthesis, but the Lithuanian and Singapore English examples clearly show how metathesis can be used productively to avoid stops in perceptually weak positions. These two cases were discussed in Côté (1997a). The Lithuanian one is analyzed in the same terms but independently by Steriade (to appear).

**A. Metathesis in Lithuanian**

In Lithuanian, verbs that end in a fricative-stop cluster undergo metathesis when followed by a consonant-initial suffix (Kenstowicz 1971; Ambrazas 1985: 60; Mathiassen 1996: 26):

(1)      STOP-FRICATIVE METATHESIS IN LITHUANIAN:

|  | URs | +Vowel | +Consonant |
|---|---|---|---|
| /-sk/ | /dresk-/ | dreskia 'he/they tear(s)' | dreksti 'to tear' |
| /-zg/ | /mezg-/ | mẽzga 'he/they knot(s)' | mègzdamas 'knotting' |
| /-ʒg/ | /dʒerʒg-/ | dʒerʒgia 'he/they scrape(s)' | dʒergʒti 'to scrape' |

I interpret this process in the following way. When the last stop of the stem precedes a vowel, it benefits from the strong contextual cues present in the transition to the vowel. If the last stop preceded a consonant, it would find itself in an inter-consonantal weak position. Metathesis of the stop and the fricative then allows both consonants to be sufficiently salient. On the one hand, the stop is strengthened by now being in post-vocalic position. On the other hand, fricatives remain perceptually salient even in inter-consonantal position.

**B. Metathesis in Singapore English**

In Singapore English (Mohanan 1992), final /-sp/ metathesizes to /-ps/. For example, *crisp* is pronounced [krips], *grasp* [grɑːps]. As in Lithuanian above, this process allows both consonants to remain acoustically salient: /p/ gains vocalic transitions from the preceding vowel, while /s/ is strong enough by itself.

**C. Consonant deletion in Farsi**

Colloquial Farsi (Darzi 1991; Mahootian 1997) productively simplifies certain consonant clusters, in particular word-finally. We can distinguish three distinct deletion processes:

1. Deletion of /ʔ/ and /h/. This occurs in numerous positions, especially in clusters but also word-finally after a vowel and even intervocalically. I disregard these cases of deletion, which involve a restricted class of glottal consonants.

2. Deletion of /r/ after an obstruent word-finally, e.g. /fekr/ → [fek] 'thought. I suspect this process is motivated by the SSP.

3. Deletion of stops in C__C and C__## contexts. This is what interests me here. Mahootian (1997) states that stop deletion applies (optionally) to /t/ after a coronal fricative /s, ʃ/ (2) and /d/ after /n/ (3).

(2)      /t/ DELETION AFTER A CORONAL FRICATIVE IN FARSI:
|  |  |  |  |
|---|---|---|---|
| a. | /dæst/ | [dæs] | 'hand' |
| b. | /dæstgire/ | [dæsgire] | 'handle' |
| c. | /dæstgah/ | [dæsgah] | 'equipment' |
| d. | /bist/ | [bis] | 'twenty' |
| e. | /rastgu/ | [rasgu] | 'truthful' |
| f. | /moʃt/ | [moʃ] | 'fist' |
| g. | /ængoʃtnema/ | [ængoʃnema] | 'notorious' |

(3)      /d/ DELETION AFTER /n/:
|  |  |  |  |
|---|---|---|---|
| a. | /qænd/ | [qæn] | 'sugar' |
| b. | /kond/ | [kon] | 'slow' |
| c. | /mund-ænd/ | [mundæn] | 'they stayed' |
| d. | /mi-neveʃt-ænd/ | [mineveʃtæn] | 'they were writing' |
| e. | /tʃænd-ta/ | [tʃænta] | 'how many' |
| f. | /bolænd-qæd/ | [bolænqæd] | 'tall' |

But according to Darzi (1991), the process extends at least to /d/ after /z/ (4), /t/ preceded by non-coronal fricatives (5), as well as stops at places of articulation other than coronal (6).

(4)     /d/ DELETION AFTER /z/:
         a.  /mozd/                    [moz]                    'wage'
         b.  /dozd/                    [doz]                    'thief'

(5)     /t/ DELETION AFTER A NON-CORONAL FRICATIVE:
         a.  /hæft/                    [hæf]                    'seven'
         b.  /gereft/                  [geref]                  '(he) got'
         c.  /loxt/                    [lox]                    'naked'
         d.  /saxt/                    [sax]                    '(he) built'

(6)     NON-CORONAL STOP DELETION:
         a.  /xoʃk/                    [xoʃ]                    'dry'

First, the process appears to be restricted to stops. No cases of fricative or nasal deletion are reported, except in the isolated example /tʃeʃm/ 'eye', pronounced [tʃeʃ] (Mahootian 1997: 336). Final /m/ does not delete in other similar words – e.g. /pæsʃm/ 'wool' – or after other consonants – e.g. /esm/ 'name', /elm/ 'science', /hokm/ 'order' – even if the SSP is violated, as in the last two examples.

Stop deletion, however, is clearly dependent on contrast between the stop and the preceding consonant. But Darzi and Mahootian differ on the amount of contrast that is necessary to block deletion. According to Mahootian, only coronal stops that are homorganic with the preceding consonant delete. So a contrast in place of articulation prevents simplification.[32] In addition, stops are dropped only after consonants that contrast minimally in manner of articulation: nasals, which contrast only in [sonorant], and fricatives, which contrast in [continuant]. Stops seem to be stable after liquids, which contrast in both [sonorant] and [continuant], or in [sonorant] and [approximant] depending on the feature system one adopts. All the reduced clusters also show no contrast in voicing. Darzi is less restrictive with respect to place of articulation, and allows the deletion of stops that are not coronal and not

homorganic with the preceding consonant. The conditions on manner of articulation, however, are identical as in Mahootian.

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[32]The role of coronality is not clear. Is it the case that non-coronal consonants may not drop in the variety described by Mahootian, or are non-coronal stops disregarded because they are much less frequent, as is the case in English (see chapter 1, section 1.2.3.3.)? Recall that Darzi does allow deletion of non-coronal stops.

# Chapter 4

# <u>CONTRAST</u>

Contrast, or its counterpart similarity, is emerging as one of the most fundamental notions in phonology.[1] The desirability of contrast between phonological elements, or the avoidance of similarity, pervades all corners of the field and manifests itself in a variety of ways. It constrains the application of phonological processes, the form of morphemes, the inventory of phonemes, and the specific realization of sounds. It applies under adjacency or at a distance, in a categorical or gradient fashion.

Much recent work focuses on the role of similarity avoidance in shaping the possible or prefered form of morphemes (Morpheme Structure Constraints), e.g. Pierrehumbert (1993, 1994a, 1994b), Berkley (1994), Frisch, Broe & Pierrehumbert (1997) and, from a different perspective, MacEachern (1997) (see also Frisch 1996). Others look at how similarity constrains the application of phonological processes: consonant deletion (Côté 1997a,b, 1998; Guy & Boberg 1997), dissimilation (Suzuki 1998), reduplication (Kelepir 1998; Wedel 1999, 2000), tonal patterns (Harrikari 1999), voicing agreement at a distance (Walker 2000, to appear).

The research just cited deals with syntagmatic aspects of contrast, between elements that cooccur in the speech stream. Phonologists have also recently explored its paradigmatic aspects, in attempts to define the role of perceptual contrast in determining inventories of phonemes and the specific realizations of phonemes in different contexts (e.g. Flemming 1995; Padgett 1997, 2000, to appear). This line of investigation draws on previous phonetic research on perceptual distance in the configuration of vocalic systems (Liljencrants & Lindblom 1972; Lindblom 1986), as well as Stevens et al's theory of enhancement features (Stevens, Keyser & Kawasaki 1986; Stevens & Keyser 1989; Keyser & Stevens 2001).

This chapter is concerned with the role of syntagmatic contrast in consonant deletion and vowel epenthesis. It elaborates on the generalization noted in chapters 1 and 2 that consonants that are more similar to adjacent segments are more likely to delete or trigger epenthesis than consonants that are more contrastive. An

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[1]The same conclusion has been reached in phonetic research. For instance, Laver (1994: 391) writes: "One of the most basic concepts in phonetics, and one of the least discussed, is that of phonetic similarity."

alternative formulation is that consonants that are more similar to adjacent segments need to benefit from the cues associated with a flanking vowel, preferably a following one.

In the first section I review the aspects of the constraint system presented in the previous chapter that are relevant to the study of contrast, and expand on them. I also compare this approach to syntagmatic contrast with previously proposed ones, in particular the OCP. It is concluded that this principle is insufficient and fails to account for the full range of effects of identity or similarity avoidance. A distinction between *absolute* and *relative* identity avoidance is introduced. In the following two sections I apply the system to several case studies of consonant deletion and vowel epenthesis, in order of increasing complexity. Catalan, Black English, and French illustrate the role of agreement in single place, voicing, and manner features in deletion and epenthesis patterns. Hungarian shows the possible interaction of manner and place of articulation. Finally, I analyze in detail the very complex pattern of word-final cluster simplification in Québec French, which most clearly illustrates the gradient effect of similarity on consonant deletion. In addition to further illustrating the role of contrast in deletion and epenthesis, this chapter allows me to demonstrate the functioning of the constraint system developed in chapter 3 with more complex cases. Similarity avoidance often interacts in particular with the greater vulnerability of stops.

## 4.1. THE PROPOSED APPROACH TO CONTRAST BETWEEN ADJACENT SEGMENTS

### 4.1.1. REVIEW OF THE CONSTRAINT SYSTEM

The approach to contrast presented in chapter 3 rests on a proposed correlation between the amount of acoustic modulation in a sound sequence and its perceptual salience (e.g. Kawasaki 1982; Ohala & Kawasaki 1985; Wright 1996; Boersma 1998). The perceptibility of consonants is assumed to be determined in part by the amount of contrast between them and their adjacent segments, hence the desirability of maximizing this contrast (see section 3.1.4). Too much similarity (as determined on a language-specific basis) may trigger a repair, here deletion or epenthesis; enough contrast between a segment and its neighbors may block deletion. A trade-off relation can be established between the elements on both sides of a segment: the more similar a consonant is to one adjacent segment, the more contrasting it wants the adjacent element on the other side to be. Since the segments that are most dissimilar to consonants are vowels, we can hypothesize that the more similar a consonant is to a neighboring segment, the more it needs to be adjacent to a vowel to comply with the Principle of Perceptual Salience.

This idea is encoded in sub-families of markedness and faithfulness constraints. Markedness constraints require that consonants that agree in some feature F with a neighboring segment be adjacent to, or followed by, a vowel. These markedness constraints, given in (13) in chapter 3, are repeated below:

(1)    MARKEDNESS CONSTRAINTS ENCODING THE ROLE OF SIMILARITY:
   a.   C(AGREE=F) ↔ V    A consonant that agrees in some feature F with a neighboring segment is adjacent to a vowel.
   b.   C(AGREE=F) → V    A consonant that agrees in some feature F with a neighboring segment is followed by a vowel.

Different features can be combined in more complex constraints of the type in (2). The inherent rankings are given in (3). (3a) is motivated by the lower perceptibility of consonants that violate a constraint of the C↔V family, in comparison with that of consonants that violate the corresponding constraint of the C→V family. (3b-c) encode the fact that the more features a consonant shares with its neighbors, the less perceptible it is, and the more stringent the requirement that it be adjacent to a vowel is. A consonant that agrees in some feature F needs an adjacent vowel more than a consonant that does not agree in F (3b). Consequently, a consonant that agrees in the features F and G needs an adjacent vowel more than one that agrees only in one of these features (3c).

(2)    COMPLEX MARKEDNESS CONSTRAINTS ENCODING SIMILARITY:
   a.   C(AGREE=F∧G) ↔ V
        A consonant that agrees in some features F and G with a neighboring segment is adjacent to a vowel.
   b.   C(AGREE=F∧G) → V
        A consonant that agrees in some features F and G with a neighboring segment is followed by a vowel.

(3)    INHERENT RANKINGS BETWEEN MARKEDNESS CONSTRAINTS:
   a.   C(AGREE=F) ↔ V >> C(AGREE=F) → V
   b.   C(AGREE=F) → V >> C → V
        C(AGREE=F) ↔ V >> C ↔ V
   c.   C(AGREE=F∧G) → V >> C(AGREE=F) → V ; C(AGREE=G) → V
        C(AGREE=F∧G) ↔ V >> C(AGREE=F) ↔ V ; C(AGREE=G) ↔ V

As discussed in section 3.2.3, MAX-C constraints against the deletion of consonants are also projected and ranked according to the consonants' relative

perceptibility. Consonants that contrast in some feature F are more perceptible than consonants that do not, and the constraints that regulate their deletion are ranked higher. This is expressed in the constraints in (4a) and the general rankings in (4b).

(4)    FAITHFULNESS CONSTRAINT ENCODING SIMILARITY AND INHERENT RANKING:
   a.   MAX-C/CONTRAST=F
        Do not delete a consonant that contrasts in some feature F with an adjacent segment.
   b.   MAX-C/CONTRAST=F >> MAX-C

In consonant deletion patterns, the desirability of contrast can often be integrated in either markedness or faithfulness constraints. When the situation arises, I have simply chosen the most transparent or simple analysis, without trying to establish broader generalizations on the domain of application of each type of constraint. Further research may limit the range of possible accounts, but, in the mean time, I do not see this indeterminacy of analysis as a problem. The basic idea remains the same: less perceptible consonants are more likely to drop than more perceptible ones. That different speakers may encode and implement this idea in various ways is not surprising, and there is no reason to expect that only one analysis is possible.

### 4.1.2. COMPARISONS WITH OTHER APPROACHES TO SYNTAGMATIC CONTRAST

Before moving to specific case studies, let us briefly discuss previous references to the idea of the desirability of contrast between adjacent segments, and its expression in terms of contrasting features. This idea is not new and has been a recurrent one in the development of the field. It dates back at least to Trnka (1936) and it has more recently been implemented in perhaps the most successful principle in post-SPE phonological theory: the Obligatory Contour Principle. When relevant, points of comparison between my proposal and these various approaches will be discussed. An important result of this section is that the approach advocated here subsumes the OCP, at least when it operates under strict adjacency, and integrates it into a more general framework based on the desirability of maintaining a sufficient amount of contrast between adjacent segments, which ultimately follows from the Principle of Perceptual Salience. In addition to the effects which are amenable to an OCP-based analysis, this approach accounts for the existence of compensatory effects between different adjacent elements in the desirability of contrast, a phenomenon termed *relative identity avoidance*. These effects cannot be handled by the standard version of the OCP, which only deals with *absolute identity avoidance*.

### 4.1.2.1. Early proposals

Trnka (1936) already proposed a Law of Minimal Phonological Contrast, which states that a segment *p* can be neither followed nor preceded in the same morpheme by a segment that differs from *p* by only one feature value. This law accounts for the impossibility of, for instance, sequences such as [fp] and [pb] in English, [ppʰ] in Sanskrit and Old Greek, [t-tʲ] in Russian, a nasal vowel and the corresponding oral one in French[2] (Trnka 1936: 57-58). Trnka's principle says nothing beyond the threshold of one contrast. The approach taken here is more global and allows any level of contrast to be relevant. Moreover, Trnka's one-feature rule does not apply to all features alike; /s/ and /t/, for instance, also differ by only one feature and /-st/ is yet a permissible sequence. This suggests that one has to look at specific features and that generalizations based on numbers of features, irrespective of their nature, are problematic.

With respect to consonant clusters in particular, Saporta (1955) suggested, on the basis of English and Spanish[3], that they should reflect the conflicting demands of hearers, who want more acoustic distinctions, and those of speakers, who try to minimize articulatory effort. These demands act in opposite directions on  the amount of contrast in clusters, and Saporta predicts that these tend to show an intermediate amount of phonological contrast, computed in featural terms (using Jakobson et al's (1952) set of distinctive features). The results support this approach, as clusters composed of highly distinctive (e.g. /ŋθ, kz/) or highly similar (e.g. /dð, bv/) consonants were less frequent than combinations with an intermediate amount of contrast (e.g. /sp, nθ/).

Cutting (1975) tested Saporta's idea with another set of consonant clusters, containing a liquid /r, l/ or a glide /j, w/, that is clusters that are all quite common. He found that clusters with the highest frequency of occurrence actually showed the greatest number of featural contrasts. He hypothesized that clusters, at least frequently occuring ones, should show a maximal rather than an intermediate amount of contrast.

The evolution of word-final clusters from Old to Modern English, studied in McCalla (1980), provides some support for the principle of minimal contrast, which disfavors sequences composed of highly similar segments. The author computes the number of phonological differences between the members of two-consonant clusters in Old and Modern English.[4] The conclusion is that all the clusters that occur only morpheme-internally (monomorphemic clusters) and contain only one feature distinction in Old English have disappeared, so that Modern English does not have any such clusters.[5] This contrasts with the fact that most clusters containing two, three, and four distinctions have been retained in the language.

Kawasaki (1982), discussing Saporta's and Cutting's studies, objects to the use of distinctive features to evaluate contrast. She points out that the actual realization of a segment highly depends on the context in which it appears, as extensive interactions take place between adjacent segments. A feature-based account of contrast does not take into consideration the possible effect of these interactions, since features are invariable attributes of segments. So she considers more appropriate to look at contrast "at the level of concrete phonetic realization of segments" (Kawasaki 1982: 54). I could add to this criticism that different featural contrasts may affect the perceptibility of segments in quite different ways, and that classifying clusters on the number of contrasting features may be misleading.

One might reply that if features have any psychological reality, we may expect that speakers abstract away from the phonetic variability when computing contrast. I have no claim to make on this issue. But I would like to point out that my approach to contrast largely escapes the objections above. The only inherent rankings I propose rest on the idea that a contrast in the features F+G is preferable to a contrast in F only or G only, or that a contrast in F is preferable to no contrast in F. This should be generally true, independently of phonetic variation. But I make no comparisons between two different features F and G, and I do not give any phonological status to the *number* of contrasting features, irrespective of their identity, unlike Trnka, Cutting, Saporta, or earlier work of mine (Côté 1997a,b, 1998).

### 4.1.2.2. The Obligatory Contour Principle

The OCP has been widely used and accepted as a principle dealing with contrast between phonological elements (see section 1.2.1.2). But it has become

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[2]Sequences of a nasal vowel and the corresponding oral one in French are actually not quite impossible, as shown by the family name *Trahan* in Québec, pronounced [traã].
[3]See Bursill-Hall (1956) for an application of this proposal to French consonant sequences.

[4]The author adopts the feature system of Jakobson, Fant & Halle (1967), but notes that the use of Chomsky and Halle's (1968) system would not alter the conclusions of the study.
[5]The only clusters in Modern English with only one contrast are /-nd/ and /-st/, which occur across morpheme boundaries as well as morpheme-internally. This favors their conservation. Note, however, that the highest frequency of deletion of final /t, d/ is precisely observed in the sequences /st/ and /nd/ (see sections 1.2.3.3. and 4.3.3.3.), yielding such rimes as *fine* / *mind* and *down* / *ground* (Vennemann 1988).

increasingly clear that, in its standard version, the OCP can only scratch the surface of the role of constrast and similarity in phonology. Consider the following definition of the OCP, from McCarthy (1986: 208):

(5)    OBLIGATORY CONTOUR PRINCIPLE (OCP):
       At the melodic level, adjacent identical elements are prohibited.

Suzuki (1998) provides a clear and detailed discussion of the limitations of such an approach to identity avoidance. I would like to mention two of the shortcomings pointed out in this work, both related to the categorical nature of this definition. (5) prohibits elements that are identical and adjacent, but is irrelevant to non-adjacent and non-identical elements. Yet evidence for a more gradient approach has been accumulating, on both the adjacency and identity dimensions. First, more similar segments are avoided more than less similar segments; the correlation between the degree of similarity between phonological elements and the extent to which they are prevented to surface is not conveyed by the standard approach to the OCP. Second, similarity avoidance does not only apply to elements that are adjacent but correlates with their proximity. The closer the distance between elements, the stronger the identity avoidance. Obviously, the avoidance is greatest when elements are strictly adjacent, but there is no reason to limit its application to this context.[6]

The approach taken here deals with gradient effects on the identity dimension. This is achieved through the hierarchy of C(AGR=F)→V and C(AGR=F)↔V constraints that can be constructed using the inherent rankings in (3). The rankings in (6), for example, encodes the fact that the more features a consonant shares with an adjacent segment, the more marked it is. The interaction of these rankings with faithfulness constraints necessarily leads to more similar segments being avoided more than less similar ones.

(6)    HIERARCHY OF AGREEMENT AND CONTRAST CONSTRAINTS:
       C(AGR=F∧G∧H)↔V >> C(AGR=F∧G)↔V  >> C(AGR=F)↔V  >> C↔V
       C(AGR=F∧G∧H)→V >> C(AGR=F∧G)→V  >> C(AGR=F)→V  >> C→V

But the effects of these constraints do not extend beyond strictly adjacent segments, as their definition in (1) makes clear. In the deletion and epenthesis

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[6]Feature geometry and the segregation of features on different planes or tiers provides no solution to the non-adjacency problem of the definition in (5). The notion of tier-adjacency has been central in the application of the OCP, but it fails to account for the effect of proximity, as discussed in Suzuki (1998).

patterns I analyze, the role of contrast does not seem to involve non-adjacent segments. The primacy of adjacent elements is expected under the perceptual approach proposed here. Contrast reflects the amount of acoustic modulation, a major component of the perceptibility of consonants. It is reasonable to suppose that the perceptibility of a segment is primarily determined by modulation in its strict vicinity, hence the adjacency restriction. But I do not exclude the possibility that the constraints in (1) should be reformulated to allow reference to non-adjacent elements. Note that Boersma (1998) establishes a sharp distinction between contrast between adjacent vs. distant elements. He suggests that contrast between adjacent elements is perceptually-based, which is also the position taken here, but that contrast between non-adjacent elements is motivated by the desire to avoid repetitions of the same articulatory gestures. I think more research is needed to determine precisely the contribution of perceptual and articulatory factors in different aspects of contrast. But if indeed the desirability of contrast between adjacent and non-adjacent elements should be distinguished, we expect that it will be handled by different sets of constraints. The task, then, would not be to reformulate the constraints in (1) but to design a different family of constraints to deal with contrast at a distance. It is unclear at this point to what extent similarity avoidance in phonology is a unified phenomenon that impacts sound patterns through one or multiple sets of constraints.

Besides the proximity and identity dimensions in contrast, clearly identified by Suzuki (1998), the deletion and epenthesis patterns investigated in this and chapters 1-2 reveal the existence of another dimension that escapes the OCP: the distinction between what I call absolute and relative similarity avoidance. *Absolute similarity avoidance* refers to situations where agreement in some feature F between two adjacent segments is not tolerated, independently of the context in which these two segments find themselves. *Relative similarity avoidance* is characterized by the presence of compensatory effects between different components of consonant perceptibility. The degree of tolerance for a certain level of similarity, expressed by featural agreement, between two adjacent segments is not determined in an absolute fashion, but depends on quality and quantity of the perceptual cues that are otherwise available to these segments. In other words, the negative effects of a similar adjacent segment on the perceptibility of a consonant can be (partially) offset by the presence of good cues in other portions of the string. In particular, similarity on one side can be compensated by having a more dissimilar segment on the other side. More specifically, the patterns described in this chapter suggest that consonants that are next to a vowel tolerate more similarity with an adjacent segment on the other side than consonants that do not benefit from the strong cues associated with an adjacent vowel.

An example will help to make the absolute/relative distinction clear. Suppose the three sequences in (7), in which $C_1$ and $C_2$ agree in a feature F. Suppose also the existence of a constraint that militates against a segment sharing the feature F with an adjacent segment.

(7)    ABSOLUTE VS. RELATIVE SIMILARITY AVOIDANCE:
       a.  $VC_1C_2V$          $C_1, C_2$=[F]                *absolute   √relative
       b.  $VC_1C_2C_XV$       $C_1, C_2$=[F]                *absolute   *relative
       c.  $VC_1C_2$##         $C_1, C_2$=[F]                *absolute   *relative

If this constraint is interpreted in an absolute fashion, the three forms in (7) are equivalent with respect to it. $C_1$ and $C_2$ are adjacent and they are both specified for F; this is sufficient to induce a violation of the constraint, no matter what other segments appear next to $C_1$ and $C_2$. But if the constraint is interpreted relatively, it may distinguish (7a) from (7b) and (7c). Specifically, it would be violated only in (7b-c). In (7a), $C_1$ and $C_2$ agree in F, but they are also adjacent to a vowel, which provides them with optimal perceptual cues. They may therefore tolerate a relatively similar segment on the other side, specifically one that shares the feature F. In (7b) and (7c), however, $C_2$ is followed by another consonant $C_X$ or by no segment, two contexts in which $C_2$ does not benefit from good contextual cues. In such situations C2 may not tolerate too similar adjacent segments on the other side, in this case segments that agree with it in the feature F.

The OCP is designed to derive cases of absolute identity avoidance: two adjacent segments cannot share one or several feature specifications, irrespective of how they stand with respect to other adjacent segments. But this principle cannot, without additional assumptions, account for cases of relative identity avoidance and the existence of trade-off effects between different sources of cues, in particular the type of segment and the elements on both sides of it. The constraint system proposed here, however, is able to handle both types of contrast effects. Constraints of the C(AGREE=F)→V family are equivalent to OCP-F constraints and deal with absolute identity. Constraints of the C(AGREE=F)↔V family directly derive the relative interpretation of similarity avoidance, and the inherent rankings in (3b-c) encode the idea that the more similar a consonant is to an adjacent segment, the better cues it needs otherwise, in particular vocalic transitions, to ensure a sufficient level of perceptual salience. The OCP is thus subsumed into a more general approach to similarity avoidance.

The interaction of the constraints C(AGREE=F)↔V >> C(AGREE=F)→V (3a) with faithfulness constraints determine whether agreement in the feature F between adjacent segments is: tolerated (FAITH ranked high, 8a), subject to relative avoidance (8b), or subject to absolute avoidance (FAITH ranked low, 8c).

(8)    DERIVING IDENTITY AVOIDANCE EFFECTS:
       a.  FAITH >> C(AGREE=F)↔V >> C(AGREE=F)→V
           Agreement in F always tolerated
       b.  C(AGREE=F)↔V >> FAITH >> C(AGREE=F)→V
           Relative avoidance of agreement in F
       c.  C(AGREE=F)↔V >> C(AGREE=F)→V >> FAITH
           Absolute avoidance of agreement in F

To illustrate the effect of C(AGREE=F)→V, C(AGREE=F)↔V, and OCP constraints, let us briefly consider three simple examples from Lenakel, French, and Hungarian introduced in previous chapters. Lenakel illustrates absolute identity avoidance, while French and Hungarian display the effect of relative identity avoidance.

We saw in section 3.3.1 that in Lenakel epenthesis obligatorily takes place between two identical consonants across a morpheme boundary (9).[7] This is an effect of the role of contrast: only sequences of consonants that are minimally distinct are tolerated; identical consonants may not appear next to each other.

(9)    EPENTHESIS BETWEEN IDENTICAL CONSONANTS IN LENAKEL:
       a.  /i-ak-kɨn/      →      [yagə́gən]                 'I eat it'
       b.  /t-r-rai/       →      [tɨrɨɾay] / [dɨrɨɾay]      'he will write'

This process was accounted for with a constraint C(AGREE=∀F)→V requiring that a consonant that agrees with an adjacent segment in all features be followed by a vowel (10a). Equivalently, we could use a standard OCP constraint (10b). These constraints crucially dominate the constraint DEP-V. This is illustrated in the following tableau.

---

[7]In sequences of coronal consonants, including identical ones, we observe deletion of the first consonant rather than epenthesis. Coronal deletion, however, fails to apply to four verbal prefixes: the future /t-/, the third person singular subject /r-/, the perfective /n-/, and the negative /ɨs-/. If one of these coronal consonants is followed by an identical consonant, the general epenthesis rule takes place, as in (9b).

(10) RELEVANT MARKEDNESS CONSTRAINTS OF THE C→V AND OCP FAMILIES:
- a. C(AGREE=∀F)→V
  A consonant that agrees in all features with a neighboring segment is followed by a vowel.
- b. OCP-Root
  No sequence of identical segments.

(11) EPENTHESIS BETWEEN IDENTICAL CONSONANTS IN LENAKEL:

| /i-ak-kɨn/ | C(AGREE=∀F)→V<br>OCP-Root | DEP-V |
|---|---|---|
| yɑggən | *! | |
| → yɑgágən | | * |

OCP-Root and C(AGREE=∀F)→V have the same effect of eliminating *any* sequence of identical segments. This is clear in the definition of the OCP constraint in (10b), but achieved somewhat indirectly by the C(AGREE=∀F)→V constraint. In any sequence of two consonants, the first one necessarily fails to be followed by a vowel. Such sequences are therefore subject to violating a C(AGREE=F)→V constraint. So a violation of C(AGREE=∀F)→V automatically follows if the two adjacent consonants are identical, as in (11).

Consider now the case of French, which is developed in more detail in section 4.2.3. As discussed in section 2.3.5.2, this language obligatorily inserts schwa between a verbal stem ending in a consonant and a 1st/2nd plural conditional ending /-rjɔ̃, -rje/ (12a). But no epenthesis takes place with stems ending in a vowel (12b).

(12) (NON-)EPENTHESIS BEFORE 1/2 PL. COND. ENDINGS IN FRENCH:
- a. *fumeriez*    'smoke+COND.2PL'    /fym+rje/    [fymərje]
- b. *finirions*    'finish+COND.1PL'    /fini+rjɔ̃/    [finirjɔ̃]

I argued that /r/ and /j/ are both glides specified as [+vocoid], and that epenthesis in (12a) is motivated by the desire for every consonant that agrees in the feature [+vocoid] to be adjacent to a vowel. I take this process to be an effect of similarity avoidance, and account for it with the constraint in (13), which dominates the constraint against epenthesis, as shown in (14). Epenthesis always takes place at morpheme boundaries; this is derived by a CONTIGUITY constraint which prohibits insertion morpheme-internally.

(13) RELEVANT MARKEDNESS CONSTRAINT OF THE C↔V FAMILY:
C(AGREE=[+vocoid]) ↔ V
A consonant that agrees in [+vocoid] with a neighboring segment is adjacent to a vowel.

(14) (NON-)EPENTHESIS BEFORE 1/2 PL. COND. ENDINGS IN FRENCH:

| /fym+rje/ | C(AGR=[+voc])↔V | CONTIGUITY | DEP-V |
|---|---|---|---|
| fymrje | (r) ! | | |
| → fymərje | | | * |
| fymrəje | | *! | * |
| /fini+rjɔ̃/ | | | |
| → finirjɔ̃ | | | |
| finiərjɔ̃ | | | *! |
| finirəjɔ̃ | | *! | * |

Notice, crucially, that epenthesis does not remove the sequence of [+vocoid] segments [rj], since schwa is inserted before the [r]: [fymərje]. This form violates an OCP-[+vocoid] constraint (15a) or its equivalent C(AGR=[+voc])→V (15b), just like the faithful output [fymrje]. These constraints are ranked below DEP-V and are too low to have an effect. So epenthesis cannot naturally be seen as derived by the OCP, which fails to establish the connection between epenthesis and identity avoidance.

(15) MARKEDNESS CONSTRAINTS OF THE C→V AND OCP FAMILIES:
- a. OCP-[+vocoid]
  No sequence of [+vocoid] consonants.
- b. C(AGREE=[+vocoid]) → V
  A consonant that agrees in [+vocoid] with a neighboring segment is followed by a vowel.

In this particular case the OCP approach could be made to work if the domain of application of the OCP constraint were restricted to the syllable. Only tautosyllabic sequences sharing the feature [+vocoid] would violate OCP-[+vocoid], heterosyllabic ones being immune to the effect of this constraint. The correct output [fy.mər.je] would not violate the OCP if the syllable break lies between [r] and [j], but [fum.rje] would, provided the indicated syllabification is the correct one. Such a solution is undesirable to the extent that the arguments that the syllable is irrelevant in accounting for deletion and epenthesis patterns are valid (see chapter 1). Moreover, it is unavailable in the Hungarian case of relative identity avoidance, sketched below and analyzed in more detail in section 4.2.4.

Recall from section 1.2.3.1. that stops may delete under certain conditions in medial position of triconsonantal clusters in Hungarian. First, stop deletion is possible if the following segment is a nasal or a stop, i.e. specified as [-continuant], but is blocked if the following consonant is [+continuant]. Second, deletion takes place only with a preceding [-approximant] consonant (an obstruent or a nasal), but not if the preceding segment is a liquid or a glide. The following data show the effect of these conditions on stop deletion.

(16)    STOP DELETION IN HUNGARIAN:

| | | No simplification | Simplification | |
|---|---|---|---|---|
| a. | *lambda* | [lɔmbdɔ] | [lɔmdɔ] | 'lambda' |
| b. | *asztma* | [ɔstmɔ] | [ɔsmɔ] | 'asthma' |
| c. | *röntgen* | [røndgɛn] | [røŋgen] | 'X-ray' |
| d. | *dombtető* | [domptɛtø:] | [domtɛtø:] | 'hilltop' |

(17)    DELETION BLOCKED IF THE PRECEDING CONSONANT IS [+APPROXIMANT]:

| | | | | |
|---|---|---|---|---|
| a. | *talpnyaló* | [tɔlpnʲɔlo:] | *[tɔlnʲɔlo:] | 'lackey' |
| b. | *szerbtől* | [sɛrptø:l] | *[sɛrtø:l] | 'from (a) Serb' |
| c. | *sejtmag* | [ʃɛjtmɔg] | *[ʃɛjmɔg] | 'cell nucleus' |
| d. | *bazaltkő* | [bɔzɔltkø:] | *[bɔzɔlkø:] | 'basalt stone' |

(18)    DELETION BLOCKED IF THE FOLLOWING CONSONANT IS [+CONTINUANT]:

| | | | | |
|---|---|---|---|---|
| a. | *aktfotó* | [ɔktfoto:] | *[ɔkfoto:] | 'nude photograph' |
| b. | *hangsor* | [hɔŋkʃor] | *[hɔŋʃor] | 'sound sequence' |
| c. | *handlé* | [hɔndle:] | *[hɔnle:] | 'second-hand dealer' |
| d. | *centrum* | [tˢɛntrum] | *[tˢɛnrum] | 'center' |
| e. | *kompjúter* | [kompju:tɛr] | *[komju:tɛr] | 'computer' |

I interpret this pattern in the following way. The motivation for the continuancy condition on the following segment relates to the audibility of the stop release burst: only [-continuant] segments, which involve a complete closure in the oral cavity, may induce a complete masking of the preceding stop burst. The requirement that the preceding consonant be [-approximant] follows from the effect of contrast: deletion only applies in the presence of a reduced contrast in manner of articulation between the stop and the preceding segment, specifically when the two consonants agree in the feature [approximant]. In other words, similarity between the stop and the preceding segment triggers deletion only in contexts where the audibility of the stop burst is threatened, i.e. only if the cues otherwise available to the stop are reduced. The presence of compensatory effects between the two sides of

the stop is clear: if the audibility of the stop burst is not threatened, any level of similarity between the stop and the preceding consonant is tolerated.

It is hard to see how an OCP approach could account for this pattern. Let us adopt an OCP-[approximant] constraint. This constraint is equally violated in [ɔstmɔ] (16b), [ɔktfoto:] (18a), and [hɔndle:] (18c), but only in the first case is deletion observed. This problem cannot be solved by restricting the application of the OCP constraint to tautosyllabic sequences. For this solution to work, we would have to adopt the following conditions: 1) all $C_1C_2C_3$ clusters are syllabified $[C_1.C_2C_3]$ if $C_3$ is [+continuant] and $[C_1C_2.C_3]$ if $C_3$ is [-continuant], and 2) the OCP only applies in *coda* clusters, and not in onset ones. Under these conditions, the OCP would be violated in [ɔst.mɔ], which contains a sequence of two [-approximant] consonants in coda position, but not in [ɔk.tfoto:] or in [hɔn.dle:]; in the first case the sequence of [-approximant] consonants appears in onset position, in the second case there is no such tautosyllabic cluster. The problem here is that neither the syllabification rule relating to the continuancy of $C_3$ nor the restriction to coda clusters is independently justified. In contrast, the solution in terms of relative identity avoidance adopted here has a clear perceptual motivation.

I have argued in this section that the OCP is insufficient as a principle that deals with the desirability of contrast between phonological elements. The approach taken here is more general and is able to account in particular for relative similarity avoidance effects, as opposed to absolute ones. The two types are handled by C(AGREE=F)↔V and C(AGREE=F)→V constraints, respectively. In addition to the French and Hungarian cases just presented, the rest of the chapter provides an analysis of stop deletion in Catalan, English, and Québec French. I take these patterns to also display relative rather than absolute similarity avoidance. In all of them stops delete word-finally but stay before vowel-initial suffixes, e.g. *cold* vs. *colder*. This contrast follows from the absence vs. presence of vocalic cues: similarity between the stop and the preceding consonant is tolerated if the stop otherwise benefits from good transition cues.[8]

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[8]As in the French case above, using the syllable as the relevant domain for the application of OCP constraints could save the OCP approach here: [l] and [d] are tautosyllabic in *cold* but heterosyllabic in *col.der*. Alternatively, it could be specified that stops may only delete in absolute word-final position. The fact that neither of these solutions is available in Hungarian shows the crucial character of this pattern in establishing the distinction between absolute and relative similarity avoidance.

## 4.2. IDENTITY AVOIDANCE: FIRST APPLICATIONS

In this section I present several deletion and epenthesis patterns conditioned by similarity with an adjacent segment on one or more dimensions. The first three cases – Catalan, Black English, and French – were chosen because they involve features pertaining to three different categories: place of articulation, laryngeal setting, and manner of articulation. The following examples – Hungarian and Siatista Greek – show the contribution of contrast in both manner and place of articulation in determining the behavior of consonants. A more complex case – Québec French – is discussed at length in section 4.3.

### 4.2.1. AGREEMENT IN [PLACE]: CATALAN

In Catalan, as mentioned in section 1.2.1.2, word-final clusters are productively simplified by deletion of the last consonant (Mascaró 1983, 1989; Bonet 1986; Wheeler 1986, 1987; Morales 1995; Herrick 1999). The process can be quite simply described in terms of two parameters. First, only stops can drop, as shown in (20), while fricatives and nasals are stable word-finally, in contexts that are otherwise identical (19).

(19)   RETENTION OF WORD-FINAL CONSONANTS OTHER THAN STOPS:
   a.   [-rs]:   *curs*    'course'    /curs/    →    [kurs] * [kur]
   b.   [-rn]:   *carn*    'meat'      /karn/    →    [karn] * [kar]
   c.   [-ls]:   *pols*    'dust'      /pols/    →    [pols] * [pol]
   d.   [-lm]:   *balm*    'balm'      /balm/    →    [balm] * [bal]
   e.   [-ns]:   *fons*    'bottom'    /fons/    →    [fons] * [fon]
   f.   [-ts]:   *pots*    'you can'   /pots/    →    [pots] * [pot]

(20)   DELETION OF WORD-FINAL STOPS:
   a.   [-rt]:   *fort*    'strong'    /fort/    →    [for]
   b.   [-lt]:   *alt*     'tall'      /alt/     →    [al]
   c.   [-nt]:   *punt*    'point'     /punt/    →    [pun]
   d.   [-st]:   *bast*    'vulgar'    /bast/    →    [bas]

(Wheeler 1987; Morales 1995)

Second, a homorganicity condition applies to consonant deletion: only stops that are homorganic with the preceding consonant may be omitted. Contrast the data in (21) and (22), which contain words ending in heterorganic and homorganic

clusters, respectively. The heterorganic ones surface intact (21), but those in (22) show deletion of the final stop.[9]

(21)   RETENTION OF NON-HOMORGANIC STOPS:
   a.   [-lp]:   *balb*    'numb'      /balb/    →    [balp] * [bal]
   b.   [-lk]:   *calc*    'calque'    /kalk/    →    [kalk] * [kal]
   c.   [-rp]:   *herb*    'herb'      /erb/     →    [erp] * [er]
   d.   [-rk]:   *arc*     'arc'       /ark/     →    [ark] * [ar]
   e.   [-sp]:   *Casp*    (a town)    /kasp/    →    [kasp] * [kas]
   f.   [-sk]:   *fosc*    'dark'      /fosk/    →    [fosk] * [fos]

(22)   DELETION OF HOMORGANIC STOPS:
   a.   [-rt]:   *fort*    'strong'    /fort/    →    [for]
   b.   [-lt]:   *alt*     'tall'      /alt/     →    [al]
   c.   [-nt]:   *punt*    'point'     /puNt/    →    [pun]
   d.   [-mp]:   *camp*    'field'     /kaNp/    →    [kam]
   e.   [-ŋk]:   *bank*    'bank'      /baNk/    →    [baŋ]
   f.   [-st]:   *bast*    'vulgar'    /bast/    →    [bas]

(Morales 1995)

Previous attempts to explain the contrastive behavior of stops, fricatives, and nasals are unsatisfactory. Wheeler (1987) suggests that word-final fricatives do not delete when they follow a stop because a process of affrication takes place, that merges the two consonants into one. Nikièma (1998) and Papademetre (1982) adopt the same idea for Québec French and Siatista Greek, respectively (these two patterns will be described below). This process is not available when a stop follows a fricative, which explains the contrast between /-st/ → [-s] and /-ts/ → [-ts]. This proposal accounts for the deletion facts in obstruent clusters, but fails to explain why stops, but not fricatives, delete after a sonorant.

Morales (1995) suggests filling this gap by using Radical Underspecification. In the account he proposes for the Catalan facts in (19)-(22), the special status of stops with respect to deletion is related to their feature specification. Stops are unspecified

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[9]Tha data are more complex than shown in (21)-(22). While clusters in (21) are never reduced, deletion in those in (22) is variable, depending on the type of cluster, the dialect, the morpho-phonological environment, and lexical factors. See Wheeler (1986), Bonet (1986), and Mascaró (1983, 1989). In particular, we observe a correlation between the likelihood of deletion and the degree of similarity in manner of articulation between the stop and the preceding consonant, which is perfectly consistent with the approach to contrast taken here. See Côté (2001) for a more complete analysis of the Catalan pattern, which integrates additional generalizations on manner of articulation.

for manner features, whereas all other segments are specified for at least one such feature ([continuant] for fricatives, [lateral] for /l/, [sonorant] for /r/, and [nasal] for nasals). According to Morales, tautosyllabic segments merge as a result of the OCP if one subsumes the other, that is if their feature specifications are identical to each other or correspond to a subset of each other. Stops being unspecified for manner, their manner specifications, i.e. Ø, are necessarily a subset of those of the preceding segment. This explains why stops can delete (through merger) whatever the preceding consonant is. However, a liquid, a nasal, or a fricative cannot be subsumed by an adjacent segment (unless it is also a liquid, a nasal, or a fricative). The homorganicity requirement follows automatically: if a final stop contains a place specification that is not contained in the previous segment, it cannot be subsumed by this segment and no merger takes place. The relevant contrasts are illustrated in (23). Notice that coronals are assumed to be unspecified for place.

(23)    MERGER AND NON-MERGER OF WORD-FINAL STOPS (Morales 1995):
    a.  Merger takes place:

    /n/      +      /t/          →      /n/                  (ex. *punt* [pun])

    [nas] Place        Place          [nas] Place

    b.  Merger does not take place because /s/ is specified for [cont]:

    /n/      +      /s/          →      /ns/                 (ex. *fons* [fons])

    [nas] Place      [cont]  Place

    c.  Merger does not take place because /k/ is specified for [vel]:

    /l/      +      /k/          →      /lk/                 (ex. *calc* [kalk])

    [lat] Place        Place

                                    [vel]

This approach yields the correct results for the data presented here because only homorganic clusters can be simplified in this language. So, no place or manner of articulation features ever get deleted. It does not extend, however, to other patterns of final stop deletion, such as those observed in Québec French and English (see section 4.3). As we will see below, non-homorganic clusters do simplify in these languages, which necessarily involves the deletion of place features; and assuming that coronals are unspecified for place is not a solution since non-coronal consonants also delete in non-homorganic clusters in Québec French. So Morales's solution does

not generalize to additional data in Québec French and English, which are otherwise similar to the Catalan ones.[10]

This approach also has to stipulate that the OCP only applies to tautosyllabic segments. Stops delete word-finally but not when followed by a vowel-initial suffix, as shown by the contrast between the base form and its diminutive in (24). The stops in the diminutive forms are preceded by a homorganic consonant, yet no deletion takes place. If [puntɛt] is syllabified as [pun.tɛt] and the OCP only applies syllable-internally, no merger takes place since the two consonants pertain to different syllables.

(24)    FINAL STOPS IN BASE AND DIMINUTIVE FORMS:

|  | *Base form* | *Diminutive* |  |
|---|---|---|---|
| a. | [pun] | [puntɛt] | 'point' |
| b. | [baŋ] | [bəŋkɛt] | 'bank' |
| c. | [kam] | [kampɛt] | 'field' |

I believe all the elements of the Catalan pattern – the restriction to stops, the homorganicity requirement, and the blocking of deletion before vowel-initial suffixes – follow from the perceptual approach advocated here. They correspond to three well-established generalizations, which are encoded in the constraint system developed in chapter 3. Consonants are more likely to delete when not adjacent to a vowel. This is particularly true of stops because of their weak internal cues. Consonants that agree in some feature with an adjacent segment are also more susceptible to deletion than consonants that do not share this feature, hence the homorganicity condition. These three factors are unified in a single markedness constraint (25a), which demands that every stop that agrees in place of articulation with an adjacent segment appear next to a vowel. This constraint inherently dominates the general constraint against consonants that are not adjacent to a vowel C↔V (25b). It crucially interacts with faithfulness constraints militating against consonant deletion (26a-c), inherently ranked as in (26d) (see (29) in section 3.2.3). MAX-C must itself be outranked by all the other faithfulness constraints which could apply here, notably DEP-V.

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[10]The merger solution also fails to explain the correlation mentioned in the previous footnote between the likelihood of deletion and the degree of similarity in manner of articulation between the stop and the preceding segment.

(25)   RELEVANT MARKEDNESS CONSTRAINTS AND INHERENT RANKING:

a.   stop(AGREE=[place]) ↔ V
     A stop that agrees in place of articulation with a neighboring segment is adjacent to a vowel.

b.   stop(AGREE=[place]) ↔ V  >> C ↔ V

(26)   RELEVANT FAITHFULNESS CONSTRAINTS AND INHERENT RANKING:

a.   MAX-C/__V          Do not delete a prevocalic consonant.
b.   MAX-C/V__          Do not delete a postvocalic consonant.
c.   MAX-C              Do not delete a consonant.
d.   MAX-C/ __V >> MAX-C/V__ >> MAX-C

The only language-specific ranking between the markedness and faithfulness constraints we need to establish to derive the Catalan pattern is given in (27). This ranking generates the deletion of all and only word-final stops that are homorganic with the preceding segment. This is shown in the tableau in (28).

(27)   RANKING SPECIFIC TO CATALAN:

stop(AGREE=[place]) ↔ V  >> MAX-C  >> C ↔ V

(28)   DELETION AND RETENTION OF WORD-FINAL CONSONANTS IN CATALAN:

| a. /punt/ | MAX-C/__V | MAX-C/V__ | stop(AGREE=[place])↔V | MAX-C | C↔V |
|---|---|---|---|---|---|
| punt |  |  | (t) ! |  | (t) |
| → pun |  |  |  | * |  |
| put |  | * ! |  |  |  |
| b. /fons/ |  |  |  |  |  |
| → fons |  |  |  |  | (s) |
| fon |  |  |  | * ! |  |
| fos |  | * ! |  |  |  |
| c. /kalk/ |  |  |  |  |  |
| → kalk |  |  |  |  | (k) |
| kal |  |  |  | * ! |  |
| kak |  | * ! |  |  |  |
| d. /punt+ɛt/ |  |  |  |  |  |
| → puntɛt |  |  |  |  |  |
| punɛt | * ! |  |  |  |  |
| putɛt |  | * ! |  |  |  |

Only the faithful form in (28a) [punt] violates the relevant markedness constraint; only it contains a stop that agrees in place with an adjacent segment without being next to a vowel. Simplification therefore occurs and yields the form [pun]. In the other examples the faithful output with the cluster surfaces because the markedness constraint is not violated: in (28b) we have a homorganic cluster but the final consonant is not a stop; in (28c) the final stop is not homorganic with the preceding consonant; in (28d) all consonants are adjacent to a vowel, in conformity with the markedness constraint stop(AGR=[place])↔V.[11]

### 4.2.2. AGREEMENT IN [VOICE]: BLACK ENGLISH

Final stop deletion in English provides a case similar to Catalan. Only stops delete (ex. *ben~~d~~* vs. *ben~~ch~~*), they do so only following another consonant (*ben~~d~~* vs. *bed*), and deletion fails to apply before a vowel-initial suffix (*ben~~d~~* vs. *ben~~d~~ing*). As explained in section 1.2.3.3, final stop deletion is favored by agreement in some feature(s) between the members of the cluster, or, in other words, disfavored by the presence of some contrast(s). The likelihood of deletion thus correlates with the degree of similarity between the final stop and the preceding consonant. Interestingly, varieties of English differ on what shared features trigger deletion. In Philadelphia English, for instance, similarity is computed over multiple features; no single feature blocks the deletion of final consonants, as is the case for place of articulation in Catalan. The Philadelphia English pattern will be discussed in conjunction with consonant deletion in Québec French, since both processes are strikingly similar.

In Black and Puerto Rican English, however, the deletion of stops in word-final clusters is closely correlated with agreement in voicing between the members of the cluster (Shiels-Djouadi 1975). Obstruent clusters all agree in voicing (29a), and a voicing contrast between the stop and the preceding consonant is only observed in

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[11]Notice that in the Catalan case we could use the absolute markedness constraint stop(AGR=[place])→V instead of its relative version stop(AGR=[place])↔V.
(i)        MAX-C/__V >> MAX-C/V__ >> stop(Agr=[place])→V >> MAX-C
The ranking in (i) yields the same results as that used in (28), since MAX-C/V__ >> stop(Agr=[place])→V crucially prevents the deletion of all consonants that are adjacent to a vowel, irrespective of whether they share place with another consonant. This would force retention of the post-vocalic stop in [pots] (19f), not included in the tableau in (28). In cases of consonant deletion, the retention of consonants adjacent to a vowel can be derived either through the high ranking of MAX-C/V__, as in (i), or the low ranking of C→V constraints, as in (28). It should be clear, however, that the relative freedom between C↔V and C→V enjoyed by cases of consonant deletion does not undermine the distinction drawn in section 4.1.2.2. between absolute and relative identity avoidance, since it does not extend to processes of vowel epenthesis, such as the Lenakel and French ones, in which the choice between C↔V and C→V is strict.

sonorant+obstruent final sequences (29c,e). For Black English, Shiels-Djouadi reports the following percentages of final coronal stop deletion after /l/, /n/, and obstruents:

(29)    PERCENTAGE OF FINAL CORONAL STOP DELETION:
   a.   O+/t,d/          72%            *Examples*:    post, buzzed
   b.   /-ld/            74%                           killed, gold
   c.   /-lt/            0%                            built, bolt
   d.   /-nd/            86%                           send, find
   e.   /-nt/            13%                           rent, pinte

The contrast between the cluster /-ld/, which shows agreement in voicing, and /-lt/, which does not, is striking: /d/ is deleted in 74% of the tokens, whereas /t/ is invariably retained. The opposition between /-nd/ and /-nt/ is similar, deletion being slightly more likely with /n/ than with /l/, all else being equal. Interestingly, the frequency of stop deletion in obstruent clusters is very close to that observed for /ld/. So the crucial factor in stop deletion in Black English appears to be agreement in voicing. Idealizing somewhat, we may say that only stops that agree in the feature [voice] with the preceding segment delete. This is completely parallel to the Catalan case, except for the identity of the relevant feature. The crucial markedness constraint is given in (30a), and the established language-specific ranking in (30b). No illustrating tableau is necessary here; the reader may just use the one in (28) and transpose it to the voicing case.

(30)    MARKEDNESS CONSTRAINT AND RANKING SPECIFIC TO BLACK ENGLISH:
   a.   stop(AGREE=[voice]) ↔ V
        A stop that agrees in voicing with a neighboring segment is adjacent to a vowel.
   b.   Ranking specific to Black English:
        stop(AGREE=[voice]) ↔ V >> MAX-C >> C ↔ V

### 4.2.3. AGREEMENT IN [+VOCOID]: FRENCH

We saw in chapter 2 (section 2.3.5.) the role played by the feature [vocoid] in the distribution of schwa. In particular, schwa epenthesis applies to ensure that every consonant that agrees in [+vocoid] with an adjacent segment is adjacent to a vowel. Epenthesis is obligatory at PW-internal morpheme boundaries but optional at PW boundaries. So we have a case where contrast interacts with the prosodic structure to derive the epenthesis facts. The relevant sequences arise with suffixes or words beginning with an /r/+glide cluster (recall that /r/ in this context is considered a

glide). The only such suffix is the 1st/2nd plural conditional ending /-rjɔ̃, -rje/. When this suffix attaches to verb stems ending in a consonant, we get an underlying sequence /Crj/ and schwa insertion is obligatory (31). This contrasts with the situation in (32), which illustrates the absence of schwa when /-rjɔ̃, -rje/ follows a verb stem ending in a vowel. The examples in (33) show that schwa is only optionally inserted in other future and conditional forms containing clusters of three consonants /CCr/, that do not involve sequences of [+vocoid] consonants.

(31)    OBLIGATORY SCHWA IN /C+rjV/:
   a.   *gâterions*      'spoil+COND.1PL'      /gat+rjɔ̃/      [gatərjɔ̃]
   b.   *fumeriez*       'smoke+COND.2PL'      /fym+rje/      [fymərje]

(32)    NO SCHWA IN /V+rjV/:
   a.   *finirions*      'finish+COND.1PL'     /fini+rjɔ̃/     [finirjɔ̃]
   b.   *créeriez*       'create+COND.2PL'     /kre+rje/      [krerje]

(33)    OPTIONAL SCHWA IN OTHER /CC+r/ SEQUENCES IN FUTURE/COND FORMS:
   a.   *posterais*      'mail+COND.1SG'       /pɔst+rɛ/      [pɔst(ə)rɛ]
   b.   *fermerais*      'close+COND.1SG'      /fɛrm+rɛ/      [fɛrm(ə)rɛ]
   c.   *adopterais*     'adopt+COND.1SG'      /adɔpt+rɛ/     [adɔpt(ə)rɛ]

At PW boundaries schwa insertion is optional between a consonant and a word beginning in an /r/+glide sequence. Relevant examples are provided in (34).

(34)    OPTIONAL SCHWA BEFORE WORD-INITIAL /r/+GLIDE SEQUENCES:
   a.   *aime rien*      'like nothing'    /ɛm rjɛ̃/      [ɛm(ə)rjɛ̃]
   b.   *Patrick Roy*    (name)            /patrik rwa/   [patrik(ə)rwa]

These facts are derived by means of markedness constraints similar to those used for Black English and Catalan above. The relevant feature is here [vocoid] rather than [place] or [voice]. In addition, the prosodic context has to be specified in the constraints since it affects the application of epenthesis. Consider the markedness constraints in (35), inherently ranked as in (36). These rankings encode the fact that PW-internal consonants and consonants that agree in [+vocoid] with an adjacent segment are less easily tolerated in positions not adjacent to a vowel than consonants at the edge of a prosodic domain, here the PW, and consonants that do not agree in [+vocoid], respectively.

(35)    RELEVANT MARKEDNESS CONSTRAINTS:

   a.  C|ø (AGREE=[+vocoid]) ↔ V
       A PW-internal consonant (which is adjacent to no prosodic boundary) that
       agrees in [+vocoid] with a neighboring segment is adjacent to a vowel.

   b.  C|ø ↔ V
       A PW-internal consonant is adjacent to a vowel.

   c.  PW[C (AGREE=[+vocoid]) ↔ V
       A consonant that is preceded by a PW boundary and agrees in [+vocoid]
       with a neighboring segment is adjacent to a vowel.

   d.  PW[C ↔ V
       A consonant that is preceded by a PW boundary is adjacent to a vowel.

(36)    INHERENT RANKINGS BETWEEN THE MARKEDNESS CONSTRAINTS IN (35):

   a.  C|ø (AGREE=[+vocoid]) ↔ V >> C|ø ↔ V
   b.  PW[C (AGREE=[+vocoid]) ↔ V >> PW[C ↔ V
   c.  C|ø (AGREE=[+vocoid]) ↔ V >> PW[C (AGREE=[+vocoid]) ↔ V
   d.  C|ø ↔ V >> PW[C ↔ V

   The repair used in French to avoid violating these markedness constraints is
epenthesis, constrained by DEP-V (37a). In French schwa is inserted at morpheme
junctures, never morpheme-internally. This is also the situation found in Chukchi, as
analyzed by Kenstowicz (1994b), who proposes that the position of the epenthetic
vowel is determined by a CONTIGUITY constraint that requires segments that are
contiguous in the lexical representation of a morpheme to also be contiguous in the
output. I adopt this position and the corresponding constraint in (37b), with a slightly
modified definition from that given in Kenstowicz (1994b: 167). This constraint is
unviolated in French.

(37)    FAITHFULNESS CONSTRAINTS:

   a.  DEP-V              Do not insert a vowel
   b.  CONTIGUITY         Segments contiguous in the lexical representation
                          of a morpheme are contiguous in the output.

   Our task is now to rank DEP-V with respect to the markedness constraints in
(36). Epenthesis is obligatory word-internally in /C+rj/ contexts. From this we can
infer the ranking in (38). Epenthesis is optional if there is no agreement in vocoid
between adjacent consonants (33)[12] or if consonants appear at the edge of a PW (34).

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[12]As seen in chapter 2, epenthesis is obligatory in all CCC sequences involving a derivational
suffix boundary, as opposed to an inflectional suffix one like the future/conditional ending. Recall

This follows from an undetermined ranking between DEP-V and the constraints in
(36b-c). We obtain the mini-grammar in (39), in which the only French-specific
ranking we had to establish is the one in (38), indicated with a thick line, the narrow
ones representing inherent rankings between markedness constraints. This
grammar is implemented in the tableau in (40), omitting the low-ranked constraint
PW[C ↔ V, which does not play a role in the data discussed in this section.

(38)    RANKING SPECIFIC TO FRENCH:
        C|ø (AGREE=[+vocoid]) ↔ V >> DEP-V

(39)    PARTIAL GRAMMAR OF FRENCH:
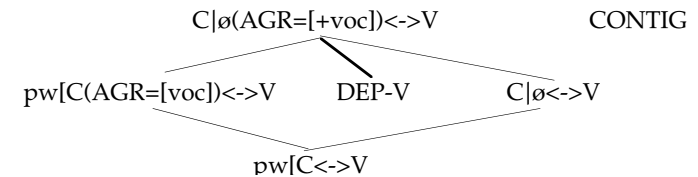


(40)    (NON-)EPENTHESIS IN SEQUENCES OF GLIDES IN FRENCH:

| a. /fym+rje/ | CONTIG | C|ø(AGR=[+voc])↔V | PW[C(AGR=[+voc])↔V | C|ø↔V | DEP-V |
|---|---|---|---|---|---|
| fymrje | | (r) ! | | | |
| → fymərje | | | | | * |
| fymrəje | * ! | | | | |
| **b. /fɛrm+rɛ/** | | | | | |
| → fɛrmrɛ | | | | (m) | |
| → fɛrmərɛ | | | | | * |
| fɛrəmrɛ | * ! | | | | |
| **c. /fini+rjɔ̃/** | | | | | |
| → finirjɔ̃ | | | | | |
| finiərjɔ̃ | | | | | * ! |
| finirəjõ | * ! | | | | * |
| **d. /ɛm rjɛ̃/** | | | | | |
| → ɛm PW[rjɛ̃ | | | (r) | | |
| → ɛmə PW[rjɛ̃ | | | | | * |
| ɛm PW[rəjɛ̃ | * ! | | | | * |

the contrast between *garderie* /gard+ri/ [gardəri] 'daycare' and *garderez* /gard+re/ [gard(ə)re]
'keep+FUT.1SG'. I assume the stricter distribution of consonants across derivational suffix
boundaries follows from an additional morphological condition which I do not consider here.

In the first example in /fym+rje/ (40a), the faithful output *[fymrje] fatally violates the constraint C|ø(AGR=[+voc])↔V. The segment [r] agrees in vocoidness with the following consonant [j] and it is not adjacent to a prosodic boundary; the constraint therefore requires that it be adjacent to a vowel, which is not the case in [fymrje]. Epenthesis must apply given the lower ranking of DEP-V, and it does so at the morpheme juncture, in conformity with CONTIGUITY; [fymə̱rje] is therefore prefered over *[fymrəje]. In /fɛrm+rɛ/ (40b), the faithful output with a three-consonant sequence [fɛrmrɛ] is tolerated. It violates only the lower-ranked markedness constraint C|ø↔V since the middle consonant [m] does not agree in [+vocoid] with an adjacent segment, making this candidate immune to the effect of C|ø(AGR=[+voc])↔V. Since C|ø↔V and DEP-V are unranked with respect to each other, schwa insertion at the morpheme juncture is also an option in this form. In the form /fini+rjɔ̃/ (40c), the faithful candidate is the only winner: [r] and [j] agree in [+vocoid] but they are both adjacent to a vowel, so none of the relevant markedness constraints is violated. A violation of DEP-V then rules out the candidate with epenthesis [finiə̱rjɔ̃]. Finally, the case in (40d) is similar to that in (40b), except that the relevant markedness constraint is PW[C (AGR=[+voc])↔V rather than C|ø↔V, which is also unranked with respect to DEP-V.

**4.2.4. INTERACTION OF MANNER AND PLACE: HUNGARIAN AND SIATISTA GREEK**

The process of consonant deletion in Hungarian was discussed at length in chapter 1. I now provide a formal analysis of it. I focus exclusively on word-internal cluster simplification and omit the degemination facts presented in the second part of section 1.2.3.1.

The generalizations for cluster simplification are given in (41). Words that meet the conditions for consonant deletion are given in (42); for these two forms are possible, with and without the cluster-medial consonant. In (43)-(45) I provide examples in which simplification is impossible because they fail to meet one of the requirements in (41b-d). I refer the reader to section 1.2.3.1 for additional examples.

(41)  a. Only the middle consonant of a three-consonant sequence deletes.
      b. Only stops delete; fricatives and affricates never do (43).
      c. Stops do not delete if preceded by a [+approximant] segment:
         glides and liquids (44).
      d. Stops do not delete if followed by a [+continuant] segment:
         glides, liquids, and fricatives (45).

(42)  DELETION WHEN ALL THE CONDITIONS IN (41) ARE MET:

|  |  | No simplification | Simplification |  |
|---|---|---|---|---|
| a. | *lambda* | [lɔmbdɔ] | [lɔmdɔ] | 'lambda' |
| b. | *asztma* | [ɔstmɔ] | [ɔsmɔ] | 'asthma' |
| c. | *röntgen* | [røndgɛn] | [røŋgɛn] | 'X-ray' |
| d. | *dombtető* | [dompthɛtø:] | [domtɛtø:] | 'hilltop' |

(43)  NO DELETION WHEN THE MIDDLE CONSONANT IS A FRICATIVE OR AFFRICATE:

| a. | *szenvtelen* | [sɛnftɛlɛn] | *[sɛntɛlɛn] | 'indifferent' |
|---|---|---|---|---|
| b. | *obskurus* | [opʃkuruʃ] | *[opkuruʃ] | 'obscure' |
| c. | *narancsból* | [nɔrɔndʲbo:l] | *[nɔrɔnbo:l] | 'from (an) orange' |
| d. | *táncdal* | [ta:ndˢdɔl] | *[ta:ndɔl] | 'popular song' |

(44)  NO DELETION WHEN THE FIRST CONSONANT IS [+APPROXIMANT]:

| a. | *talpnyaló* | [tɔlpnʲblo:] | *[tɔlnʲblo:] | 'lackey' |
|---|---|---|---|---|
| b. | *szerbtől* | [sɛrpthø:l] | *[sɛrthø:l] | 'from (a) Serb' |
| c. | *sejtmag* | [ʃɛjtmɔg] | *[ʃɛjmɔg] | 'cell nucleus' |
| d. | *bazaltkő* | [bɔzɔltkø:] | *[bɔzɔlkø:] | 'basalt stone' |

(45)  NO DELETION WHEN THE LAST CONSONANT IS [+CONTINUANT]:

| a. | *aktfotó* | [ɔktfoto:] | *[ɔkfoto:] | 'nude photograph' |
|---|---|---|---|---|
| b. | *hangsor* | [hɔŋkʃor] | *[hɔŋʃor] | 'sound sequence' |
| c. | *handlé* | [hɔndle:] | *[hɔnle:] | 'second-hand dealer' |
| d. | *centrum* | [tˢɛntrum] | *[tˢɛnrum] | 'center' |
| e. | *kompjúter* | [kompju:tɛr] | *[komju:tɛr] | 'computer' |

The first generalization in (41a) has a clear interpretation: only consonants that are not adjacent to a vowel ever get deleted. Only stops delete (41b), and they do so only if followed by a [-continuant] segment (41d). I proposed in sections 3.1.2 and 3.1.3 that the motivations for these restrictions have to do with the weakness of stops' internal cues and the audibility of the stop burst. In addition, a contrast in the feature [approximant] between the stop and the preceding segment blocks deletion (41c). This contrast condition actually generalizes to any adjacent segment (not only the preceding one) since stops may not delete either if followed by a [+approximant] consonant (since all [+approximant] segments are also [+continuant]).

These conditions all ensure that only the least perceptible consonants delete. These factors could in principle be integrated into faithfulness (MAX-C) or markedness (C↔V) constraints, as illustrated in the table in (35) in chapter 3. I use here perceptually-motivated faithfulness constraints. The relevant ones are given in

(46), together with the inherent rankings that can be established between them. The ranking in (46f) in particular ensures that if deletion occurs, it necessarily targets the cluster-medial consonant, the one not adjacent to any vowel.

(46)    FAITHFULNESS CONSTRAINTS AND INHERENT RANKINGS:
    a.  MAX-C(-stop)
       Do not delete a consonant that is not a stop.
    b.  MAX-stop/__[+cont]
       Do not delete a stop that is followed by a [+cont] segment.
    c.  MAX-C/CONTRAST=[approximant]:
       Do not delete a consonant that contrasts in the feature [approximant] with an adjacent segment.
    d.  MAX-C(-stop) >> MAX-C
    e.  MAX-C/CONTRAST=[approximant] >> MAX-C
    f.  MAX-C/ __V >> MAX-C/V__ >> MAX-C

The derive the facts in (42)-(45), these faithfulness constraints will be ranked with respect to the simple markedness constraint C↔V, which requires every consonant to be adjacent to a vowel. The specific rankings in (47) are established; they ensure that non-stops, stops followed by a [+cont] segment, and consonants that contrast in the feature [approximant] never delete. We obtain the mini-grammar in (48), with inherent rankings indicated with thin lines, specific ones with thick lines. The variability of stop deletion is derived from the indeterminacy of the ranking between MAX-C and C↔V.

(47)    RANKINGS SPECIFIC TO HUNGARIAN:
    a.  MAX-C/CONTRAST=[approximant] >> C ↔ V
    b.  MAX-C(-stop) >> C ↔ V
    c.  MAX-stop/__[+cont] >> C ↔ V

(48)    PARTIAL GRAMMAR OF HUNGARIAN I:

Max-stop/__[+cont]    Max-C(-stop)    Max-C/CONTR=[app]    Max-C/_V
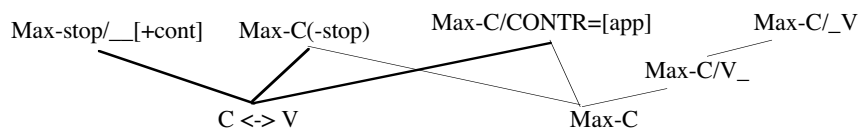
Max-C/V_

C <-> V                    Max-C

The tableau below illustrates with one example from each of the four groups of data in (42)-(45) how this grammar generates the correct output in all cases.

(49)    STOP DELETION IN HUNGARIAN:

| a. /lɔmbdɔ/ | Max-C/V__ | Max-C/CT=[app] | Max-stop/__ [+cont] | Max-C(-stop) | Max-C | C↔V |
|---|---|---|---|---|---|---|
| → lɔmbdɔ |  |  |  |  |  | (b) |
| → lɔmdɔ |  |  |  |  | * |  |
| lɔbdɔ | *! |  |  | * |  |  |
| b. /opʃkuruʃ/ |  |  |  |  |  |  |
| → opʃkuruʃ |  |  |  |  |  | (ʃ) |
| opkuruʃ |  |  |  | *! |  |  |
| c. /ʃɛjtmɔg/ |  |  |  |  |  |  |
| → ʃɛjtmɔg |  |  |  |  |  | (t) |
| ʃɛjmɔg |  | *! |  |  |  |  |
| d. /ɔktfoto:/ |  |  |  |  |  |  |
| → ɔktfoto: |  |  |  |  | (t) |  |
| ɔkfoto: |  |  | *! |  |  |  |

In (48b-d) deletion of the medial consonant violates a high-ranking faithfulness constraint, which crucially dominates C↔V. The faithful output with the full cluster, which violates the markedness constraint, therefore wins. In /opʃkuruʃ/ (48b), deletion of the medial fricative violates MAX-C(-stop). In [ʃɛjtmɔg] (48c), the medial stop contrasts in [approximant] with the preceding glide, and its deletion entails a violation of MAX-C/CONTRAST=[approximant]. In [ɔktfoto:] (48d), the medial stop is followed by a fricative, a [+continuant] segment, and deleting it leads to the violation of MAX-stop/__[+cont]. In [lɔmbdɔ] (48a), however, deletion of the medial [b] only entails a violation of the lower-ranked MAX-C; this consonant is not subject to any of the higher-ranked faithfulness constraint. Retention of the full cluster violates C↔V. Since MAX-C and C↔V are unranked with respect to each other, we observe optional deletion in this form. If deletion applies, though, it obligatorily targets the cluster-medial consonant because of the inherent ranking in (46f), which rules out the candidates with deletion of the postvocalic or prevocalic consonant *[lɔbdɔ] and *[lɔmbɔ].

We may now integrate the more subtle effect of homorganicity on the likelihood of stop deletion in Hungarian. It appears that when the conditions for deletion are met, not all stops are as likely to be dropped. A medial stop more readily deletes when it agrees in place of articulation with the preceding consonant than when it does not. Compare the two forms in (50), which contrast in the place of articulation of the medial stop – velar in (50a), alveolar in (50b). Both stops may be dropped but deletion is more frequent and natural in *parasztból*, in which the first two consonants of the cluster share the same point of articulation, than in *Recskből*.

(50)  EFFECT OF HOMORGANICITY ON THE LIKELIHOOD OF STOP DELETION:
   a.  *Recskből*        [rɛdʒgbøːl]        [rɛdʒbøːl]   'from Recsk'
   b.  *parasztból*      [pɔrɔzdboːl]       [parazboːl]  'from the peasant'

This homorganicity condition may be integrated into our system of faithfulness constraints with the constraint in (51a), which is inherently ranked higher than the simple MAX-C constraint (51b). Like MAX-C, this new constraint remains unranked with respect to C↔V, which results in the optionality of deletion. But the inherent ranking in (51b) yields the desired effect on the likelihood or frequency of deletion. There are three possible rankings of the constraints in (51b) and C↔V, given in (52). In two of them MAX-C ranks below C↔V, as opposed to only one for MAX-C/Contrast=[Place]. If we assume that the likelihood of outputs is determined by the proportion of rankings that derive them, deletion is more likely if there is agreement in place. The mini-grammar in (48) is updated as in (53).

(51)  ADDITIONAL FAITHFULNESS CONSTRAINT AND INHERENT RANKING:
   a.  MAX-C/CONTRAST=[Place]
       Do not delete a consonant that contrasts in place of articulation with an adjacent segment.
   b.  MAX-C/CONTRAST=[Place] >> MAX-C

(52)  POSSIBLE RANKINGS OF THE CONSTRAINTS IN (51) AND C↔V:
   a.  **C↔V** >> MAX-C/CONTRAST=[Place] >> MAX-C   → Deletion in (50a-b)
   b.  MAX-C/Contrast=[Place] >> **C↔V** >> MAX-C   → Deletion only in (50b)
   c.  MAX-C/Contrast=[Place] >> MAX-C >> **C↔V**   → No deletion

(53)  PARTIAL GRAMMAR OF HUNGARIAN II:

Max-stop/__[+cont]   Max-C(-stop)   Max-C/CONTR=[app]        Max-C/_V

                                                          Max-C/V_

        C <-> V     Max-C/Cont=[pl]

                        Max-C
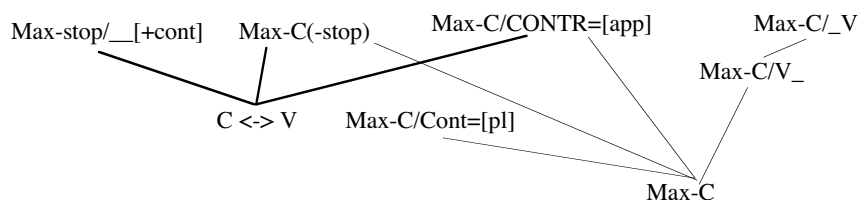
Hungarian illustrates a situation where the possibility of consonant deletion is determined by contrast in manner of articulation, in this case the feature [approximant], with contrast in place of articulation playing a secondary role in the likelihood of deletion. Interestingly, the Greek dialect of Siatista provides an example of the opposite situation: both homorganicity and similarity in manner of

articulation play a role, but the former is more important than the latter. Siatista Greek (Papademetre 1982) obligatorily simplifies homorganic triconsonantal clusters but leaves non-homorganic ones unchanged. Relevant examples of this process are given in (54a-b). (Note that these clusters arise from the deletion of high vowels). In addition, cluster simplification is optionally allowed if the members of the cluster do not show a sufficient contrast in manner of articulation. In (54d), the word-initial cluster is composed of three obstruents (a fricative, an affricate, and a stop), a sequence which contains an insufficient contrast in manner of articulation, unlike the stop-fricative-liquid cluster in (54c).

(54)  CONSONANT DELETION IN SIATISTA GREEK:
   a.  No deletion in non-homorganic clusters:
   ʃtʲm:  /stimoni/   'spindle'        →   ʃtʲimoni   →   [ʃtʲmon]
   b.  Deletion in homorganic (coronal) clusters:
   ʃtʲn:  /stinora/   'on time'        →   ʃtʲinora   →   [ʃnora]
   c.  No deletion in clusters with sufficient dissimilarity in manner:
   kʃl:   /ksilas/    'lumberjack'     →   kʃilas     →   [kʃlas]
   d.  Optional deletion in clusters without sufficient dissimilarity in manner:
   çtʲp:  /xtipo/     'I hit'          →   çtʲipo     →   [çtʲpo]/ [xpo]

What counts as sufficient or insufficient contrast in manner of articulation is not totally clear from Papademetre's description and I will not attempt to provide explicit constraints and a formal analysis for the Siatista Greek case. Note finally that the same hierarchy between homorganicity and similarity in manner of articulation seems to hold in the Indian variety of English described by Khan (1991). Words ending in monomorphemic /-st/, /-nd/, and /-ld/ lose their final stop significantly more often than words ending in /-kt/ and /-pt/, even though the latter are more similar in terms of manner of articulation.[13]

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[13]Khan, in fact, does not take place of articulation into consideration. Her conclusion about these facts is that "a preceding stop tends to act as a constraint on final stop deletion, whereas a preceding spirant or sonorant tends to favor deletion" (p. 291). But it appears that all her examples with fricatives and sonorants involve homorganic clusters, whereas two stops cannot share the same place of articulation in this context. Given the words and clusters she has chosen to present in her paper, both my and her conclusions are logically possible. But the facts support the homorganicity analysis. Khan's claim would mean that it is *dissimilarity* in manner of articulation that favors reduction. This is contrary to what we know about cluster simplification in other languages. Yet the other facts she presents on cluster reduction in Indian English completely parallel the known cases. This dialect behaves as expected with respect to agreement in voicing, which favors cluster reduction (although apparently less so than in Black and Puerto Rican English, see section 4.2.2). But more importantly, /-st/ clusters simplify more often than /-ld/ ones. This is inconsistent with the claim that similarity in manner of articulation acts as a barrier to cluster reduction, but is completely predicted under the contrast-based account I propose.

## 4.3. CLUSTER SIMPLIFICATION IN QUÉBEC FRENCH

In this section I analyze in great detail the complex pattern of word-final cluster simplification in Québec French (QF). I propose that simplification in QF is motivated by two distinct factors: the Sonority Sequencing Principle and the Principle of Perceptual Salience. The SSP is violated in all clusters whose last consonant is more sonorous than the preceding one, for example in *bible* 'bible' /bibl/ or *organisme* 'organism' /ɔrganism/. In all such cases final consonant deletion is observed, but its frequency is proportional to how severely the cluster violates the SSP. Among the clusters that do not violate the SSP, some always surface unreduced (e.g. *parc* 'park' /park/, *éclipse* 'eclipse' /eklips/, while others allow simplification, with more or less regularity (e.g. *piste* 'trail' /pist/, hymne 'hymn' /imn/). I argue that the factor that determines the behavior of clusters is perceptual salience. Only the least salient consonants may delete and frequency of deletion correlates with the relative perceptibility of the consonants. The most important elements in computing perceptibility are contrast and the greater vulnerability of stops. Clusters composed of highly dissimilar segments are stable, those containing highly similar consonants automatically lose the final consonant. But in a subset of clusters involving an average level of similarity or contrast, only final stops delete, unlike other categories of consonants. The relative degree of contrast in a cluster is determined mainly by manner of articulation, but place and voicing also play a substantial role.

The discussion is organized as follows. In the first section I present the possible final clusters in French and the previous analyses of cluster reduction in Québec French that have been proposed. The following section is devoted to clusters that violate the SSP; I first present the facts and suggest an analysis that relies on a (sequential and) gradient definition of the SSP. In section 4.3.3 I turn to the remaining clusters (those that do not violate the SSP). The facts are much more complex but a well-motivated analysis is available in the perceptual framework proposed here. It involves simple faithfulness and markedness constraints dealing with contrast/similarity and manner of articulation, which interact in intricate ways. Finally I discuss the pattern of final coronal stop deletion in Philadelphia English (Guy & Boberg 1997), which shows a striking resemblance with the Québec French one.

### 4.3.1. ATTESTED FINAL CLUSTERS AND PREVIOUS ANALYSES

Modern French displays a large number of word-final consonant clusters. Some of them are survivals of clusters that resulted from apocopes that took place in Old French; others are more recent and stem from the introduction and borrowing of new words, and from spelling-based reformations that restored consonants which had ceased to be pronounced. But the bulk of modern word-final clusters arose from the loss of word-final schwas in the pronunciation of French in the seventeenth century (see Fouché 1961 for the evolution of consonants in French).

Most final clusters are made up of two consonants. In Standard or general French, all combinations of an approximant[14], a nasal, a fricative, and a stop are attested in these clusters, except for nasal+approximant and fricative+fricative. But examples of these missing combinations can be found in non-standard or regional dialects, in particular QF, on which this section focuses. Three-consonant clusters are predictably much more limited and there is only one four-consonant cluster.

Table 5 gives the possible word-final sequences of consonants, with examples for each category. This table was established in large part on the basis of the exhaustive list of attested clusters in French provided by Dell (1995). I have omitted from Dell's list two categories of final clusters, and refer the reader to Dell's article for the complete list:
1) clusters only found in one or two rare words, generally borrowed technical terms, which are unknown to both Dell and me (Dell marks words unknown to him with an asterisk);
2) clusters only attested in words used in European varieties of French but unknown in Québec.
But I have added to Dell's list clusters attested in words that pertain to QF but not to Standard or general French. Such words are indicated by italics.[15]

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[14] I use "approximant" instead of "liquid" to refer to /r/ and /l/ together since I consider /r/ to be a glide, at least in this position. I motivated this decision for Parisian French in chapter 2 (section 2.3.2). The same arguments apply to QF.

[15] I adopt the symbol 'r' for the rhotic, irrespective of the actual pronunciation of that sound, which can take different forms in French. In Québec French, the apical [r] is still common, especially among the older generations, but is losing ground to the uvular one, which is considered the norm; see Clermont & Cedergren (1979) and Tousignant et al. (1989), as well as Picard (1987).

Table 5: **Possible word-final clusters in French**

| A=approximants | S=stops | F=fricatives | N=nasals |
|---|---|---|---|

| Type | Combinations | Examples |
|---|---|---|
| AA | /rl/ | perle 'pearl', parle 'speak', Charles |
| AN | /lm/ | calme 'calm', film 'film'; |
| | /rm, rn, rɲ/ | arme 'weapon'; corne 'horn'; épargne 'savings' |
| AF | /lv, lf, ls, lʒ/ | valve 'valve'; golf 'golf'; valse 'waltz'; belge 'Belgian' |
| | /r/ + any F | énerve 'irritate'; surf 'surf'; quatorze 'fourteen'; |
| | | force 'strength'; orge 'barley'; arche 'arch' |
| AS | /l/ + any S | bulbe 'bulb'; Alpes 'Alps'; solde 'sale', Donald; |
| | | révolte 'revolt'; algue 'seaweed'; calque 'tracing' |
| | /r/ + any S | barbe 'beard'; harpe 'harp'; corde 'cord'; tarte 'pie'; |
| | | orgue 'organ'; barque 'boat' |
| NA | /ml/ | *jumele* 'pair, twin+PRES (non-standard)' |
| NN | /mn/ | hymne 'hymn', indemne 'safe (of a person)' |
| NF | /nʃ, nz/ | Loanwords: ranch, lunch; *Ben's* |
| NS | /nd,nt,mp,ɲk,ŋg/ | Loanwords: week end, sprint; *bump*; punk; ping-pong |
| FA | /fl, fr, vr/ | pantoufle 'slipper'; chiffre 'number'; livre 'book' |
| FN | /sm/ | enthousiasme 'enthusiasm', tourisme 'tourism' |
| FF | /vz/ | *Reeves* (proper name) |
| FS | /ft, sp, st, sk/ | *shift* 'shift'; *Deraspe* (name); vaste 'vast'; risque 'risk' |
| SA | /bl, pl, gl, kl, dl/ | table 'table'; couple 'couple'; ongle 'nail'; cycle 'cycle'; |
| | | jodle 'yodel+PRES' |
| | any S + /r/ | chambre 'room'; propre 'clean'; cadre 'frame'; autre |
| | | 'other'; pègre 'underworld organization'; sucre 'sugar' |
| SN | /gn, tm, gm, km/ | stagne 'stagnates'; rythme 'rhythm'; |
| | | énigme 'enigma'; drachme 'drachma' |
| SF | /ps, ts, ks, dʒ, tʃ/ | éclipse 'eclipse'; ersatz; taxe 'tax'; Cambodge; sandwich |
| SS | /pt, kt/ | apt 'apt'; directe 'direct' |
| AFS | /rst/ | verste 'verst' |
| ASA | /ltr, lkr/, /rkl/ | filtre 'filter'; sépulcre 'sepulchre'; cercle 'circle' |
| | /rbr,rpr,rdr,rtr/ | arbre 'tree'; pourpre 'purple'; ordre 'order'; Sartre |
| ASF | /rts, rtʃ, rks/ | Loanwords: hertz, quartz; bortsch; Marx |
| ASS | /lpt/ | sculpte 'sculpt+PRES'[a] |
| FSA | /str, skl/ | orchestre 'orchestra'; muscle 'muscle' |
| SFS | /kst/ | texte 'text', mixte 'mixed' |
| SSA | /ptr, ktr/ | sceptre 'scepter'; spectre 'specter' |
| SFSA | /kstr/ | ambidextre 'ambidextrous' |

[a] The stem *sculpt-* (in forms of the verb *sculpter* 'sculpt', *sculpteur* 'sculptor', *sculpture* 'sculpture', etc.) is normally pronounced [skylt], without the medial [p]; this is the standard pronunciation indicated in dictionnaries. But the spelling-based pronunciation with a [p] is also attested.

Word-final cluster simplification is a widespread and productive process in QF, much more so than in the Northern France variety described in chapter 2, for example. To give an idea of its frequency in QF, Kemp, Pupier & Yaeger (1980: 30) estimate that in everyday conversation more than 80% of the population conserve less than 10% of the final-cluster tokens that are susceptible to simplification. But notice that the majority of cluster tokens attested in speech are of the obstruent+liquid type, which show the greatest propensity to final deletion.

The first description and analysis of cluster reduction in QF that I know of was proposed by Pupier & Drapeau (1973). Subsequent discussions include Kemp, Pupier & Yeager (1980), Walker (1984), Nikièma (1998, 1999), and Thériault (2000). I have also myself investigated this deletion pattern in Côté (1997a,b, 1998).[16] In fact, it is fair to say that the first seed of this dissertation is to be found in this early encounter with consonant deletion in my own speech. Pupier & Drapeau (1973) discuss the relevant data and develop a SPE-type of analysis (in which they integrate some elements of sociolinguistic variable rules). Kemp et al. (1980) focus on the sociolinguistic aspects of this process and adopt for the most part the empirical conclusions and phonological analysis of Pupier & Drapeau (1973). Walker (1984) only provides a partial discussion as part of a general description of the phonology of Canadian French. Nikièma (1998, 1999) proposes an analysis cast in the framework of Government Phonology. Finally, Thériault (2000) sketches an analysis of word-final consonant deletion in the framework of Declarative Phonology; the schematic format of the manuscript and my lack of familiarity with the theoretical framework, however, do not allow me to discuss and assess the proposed analysis.

The present analysis relies on the same basic idea as my previous papers (Côté 1997a,b, 1998), but it includes more facts and it is integrated into a general approach whose underlying motivations and basic elements are more clearly established. A crucial element of these first analyses, however, is abandoned: the idea that consonant deletion may be driven by *numbers* of contrasting features between adjacent elements, irrespective of their nature. This approach to contrast worked for the set of data considered in these earlier papers but does not extend to the additional facts analyzed here. Moreover, as noted above, all features do not have an equivalent effect on perceptibility and it seems now unlikely to me that features can be simply counted in the application of phonological processes.

[16]Côté (1997b) is a reduced version of (1997a). Côté (1998) is written in French and contains a slightly revised analysis.

Two points of comparison between my treatment of cluster simplification in QF and previous ones should be mentioned, one empirical, one theoretical. First, previous investigations suffer from a certain degree of empirical inadequacy. They all fail to consider a small but important group of data, and consequently draw misleading descriptive generalizations with respect to the classes of clusters that can and cannot be reduced. They propose in particular that no consonant can drop after a liquid, and that final fricatives are always stable, two generalizations which are contradicted by the facts. I will get back to this when we discuss the relevant clusters, but this result obviously affects the (a posteriori) empirical adequacy of their analysis. Only Nikièma (1999) partly integrates the empirical results published in Côté (1997a, 1998); we will return shortly to this paper.

Second, independently from this empirical issue, Pupier & Drapeau (1973), Kemp et al. (1980), and Nikièma (1998, 1999) propose a unique simplification rule for QF, whereas I take the process to be driven by two distinct but well-defined factors: sonority (the SSP) and Perceptual Salience. Although the desire to find a unified account is certainly justified, I believe the present analysis gains in naturalness and simplicity (at least from a conceptual point of view, if not in the actual implementation), while being empirically adequate. By contrast, the SPE-type rule posited by Pupier & Drapeau (1973) and Kemp et al. (1980) is extremely complex and makes the process look arbitrary. Moreover, the level of complexity of the rule would be significantly increased if it were to integrate the additional data included here but not taken into consideration in these early studies. As for Nikièma's (1998, 1999) analysis in the framework of Government Phonology, it is conceptually rather simple but it simply fails to account for the data.

Nikièma (1998) relies on Pupier & Drapeau's (1973) description of the facts, which, as noted above, is insufficient. Nikièma (1999) is a published version of the 1998 manuscript, but integrates some additional empirical findings taken from Côté (1997a, 1998). Nikièma's analysis rests on the requirements of Government Licensing and the impossibility in QF for more than one consonant to be properly licensed word-finally. Any additional consonant must then delete, and Nikièma's analysis predicts that all final clusters should behave identically in this respect. All cases of unreduced clusters must then be explained by independent factors. First, consonants generally fail to delete after a liquid. This is explained by the fact that post-vocalic liquids may be syllabified as part of the nucleus rather than the rime. In Nikièma (1998), the retention of post-liquid consonants and the proposed rule of liquid syllabification are taken to be exceptionless. Nikièma (1999) acknowledges cases of stop deletion in /-ld/ clusters, and consequently relaxes this syllabification rule. Liquids may be part of the nucleus or the rime: in the first case deletion of the

following consonant is not expected, in the second case it is. But Nikièma fails to account for the specific behavior of /-ld/, the only liquid-initial cluster which may undergo reduction. The syllabification of liquids is taken to be an idiosyncratic feature of lexical items, which amounts to simply marking final consonant deletability or non-deletability in the lexicon. Second, several types of non-liquid-initial clusters are also stable: nasal+fricative, stop+fricative, and subsets of nasal+stop, fricative+stop, obstruent+nasal clusters. For final stop+fricative sequences, Nikièma suggests (without discussion) that they form single complex segments and should not be considered clusters. But this proposition does not seem to be independently justified, and it still provides no explanation for the other types of unreduced clusters, which the author apparently treats as exceptions. More generally, Nikièma's analysis leaves unexplained the observed contrast between stops and other consonants in their propensity to delete. It is also unable to account for clear distinctions among reduceable clusters as to the automaticity of consonant deletion: simplification is almost categorical for some clusters, but highly variable and lexically-determined for others. It is, I believe, a major advantage of the analysis proposed here to provide a principled account for these facts.[17]

### 4.3.2. CLUSTER REDUCTION AND SONORITY

The SSP and the sonority hierarchy I adopt among consonants are repeated below, from chapter 1. I take /l/ to be a liquid but consider that /r/ has an unstable sonority value, ranging from that of a fricative to that of a glide. This depends on the context, as in the variety of French described in chapter 2. In the contexts examined in this section, /r/ appears postvocalically or in postconsonantal word-final position. In both cases /r/ is preferably articulated as an approximant and I take it to be a glide. The distinction drawn between /r/ and /l/ has no effect on the role of sonority in cluster reduction but is crucial to my proposal concerning the role of perceptual salience and contrast in section 4.3.3.2.

*Sonority Sequencing Principle:*    Sonority maxima correspond to sonority peaks.
*Sonority hierarchy:*    glides (G) > liquids (L) > nasals (N) > obstruents (O)

Clusters that violate the SSP comprise the obstruent+/r,l/, obstruent+nasal and nasal+/l/ sequences. We will look at each of these combinations in turn. I

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[17]Nikièma (1999) criticizes Côté (1997a, 1998) at length for not accounting for the data. Strikingly enough, however, he only considers sonority as a motivating factor for cluster simplification in my analysis, and completely disregards the role of phonetic salience, yet the main element of my approach, and the only one discussed in Côté (1998). The "counterexamples" to my analysis brought by Nikièma all fall under the scope of salience and were clearly accounted for in the papers cited. Nikièma's criticism can therefore be dismissed.

consider only final clusters comprised of two consonants. It should be clear after I provide the complete analysis that the proposed generalizations extend automatically to clusters of more than two consonants.

### 4.3.2.1. Obstruent-approximant clusters

Obstruent+approximant final clusters are by far the most frequent in the language (Malécot 1974; Kemp, Pupier & Yaeger 1980) and their behavior is quite clear. Approximant deletion in these clusters is a well-known process in French. What distinguishes QF from the Parisian varieties described in e.g. Dell (1973/1980/1985) and Tranel (1987b) is the pervasiveness of the phenomenon, which applies almost categorically in all contexts and for all words. Here are a couple of examples of stop+/r/ and fricative+/l/ final clusters in pre-consonantal, pre-pausal, and pre-vocalic position:[18]

(55)    O+A FINAL CLUSTERS IN —C, —V, AND —# CONTEXTS:
   FA: —C: *pantoufle bleue*   'blue slipper'   /pãtufl blø/ → [pãtʊfblø]
      —#: *pantoufle*   'slipper'   /pãtufl/   → [pãtʊf]
      —V: *pantoufle orange* 'orange slipper' /pãtufl ɔrãʒ/→ [pãtʊfɔrãʒ]
   SA: —C: *sucre dur*   'hard sugar'   /sykr dyr/   → [sʏkdᶻʏr]
      — #: *sucre*   'sugar'   /sykr/   → [sʏk]
      — V: *sucre arabe*   'Arabic sugar'   /sykr arab/ → [sʏkarab]

The fact that these clusters simplify systematically in all contexts raises the obvious question of whether clusters are present in the underlying forms. That is, are we dealing here with a synchronic or a historical reduction process? In some cases, the almost automatic deletion of the final consonant has led to a reanalysis of the underlying representation, which has lost the final consonant. For example, *crisse* (swear word) /kris/ derives from *Christ* 'Christ' /krist/. Similar examples include 1. *tabarnac* (swear word) /tabarnak/ < *tabernacle* 'tabernacle' /tabɛrnakl/; 3. *piasse* 'dollar' /pjas/ < *piastre* 'piastre' /pjastr/; 4. *canisse* 'container' /kanis/ < *canistre* /kanistr/. This reanalysis is apparent in derived words in which a vowel-initial suffix is added, such as the infinitive marker /e/ in *crisser* /kris+e/ and the

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[18]The phonetic transcriptions of QF include a few allophonic processes that are not part of the phonological system of Parisian French: 1. laxing of high vowels in closed syllables, except before /r,v,z,ʒ/ (with laxing harmony spreading to the left in certain cases), 2. dipthongization of long vowels in closed syllables, 3. affrication of /t/ and /d/ before high front vowels. Note that these processes are irrelevant to the issues addressed here. QF also differs from Parisian French in the quality of certain nasal vowels (ẽ and ã instead of ɛ̃ and ɑ̃), the stability of œ̃ (which does not merge with ɛ̃), and the presence of at least one additional phonemic vowel: /ɜ/, which contrasts with /ɛ/, e.g. *fête* 'holiday' /fɜt/ vs. *fait* /fɛt/ 'done' (with the final /t/ normally pronounced).

adjectival suffix -*ant* /ã/ in *tabarnacant* /tabarnak+ã/. Such changes in underlying forms are obviously favored when words are not related to morphologically derived forms in which the final consonant resurfaces, which point to the important role of the morphology in maintaining these final clusters in lexical representations.

Disregarding these obvious cases of reanalysis, traditional derivational analyses would argue that the final approximant is necessary in underlying representations to get morphologically derived words, like *pantouflard* 'stay-at-home' /pãtuflar/ from *pantoufle* and *sucrier* 'sugar bowl' /sykrije/ from *sucre*. But these are not productive derivations, and it is not clear that such words are derived synchronically from the base noun. There is little doubt, however, that a deletion process is synchronically active in verbs of the first conjugation, the most productive one. Consider verb stems ending in an obstruent+approximant cluster. These verbs appear without the final approximant in their bare form, but with the full cluster when followed by a vowel-initial suffix. The bare form is used in the indicative and subjunctive present tense (except in the 2nd plural, as well as the 1st plural in written and formal registers). (56) gives one such example:

(56)    STEMS ENDING IN O+A IN THEIR BARE FORM AND FOLLOWED BY A VOWEL:
   a. *cibler*   'target+INFINITIVE'   /sibl+e/   → [sible]
   b. $ *cible(cibles/ciblent)*   'target+PRES(ENT)'   /sibl/   → [sɪb]

From now on, I will use regular verbs of the first conjugation as often as possible, as a means to ensure that we are dealing with a synchronic process of deletion. Examples involving such verbs will be preceded by a "$", as in (56b) above (think of these examples as more valuable). Words other than verbs will be added when relevant or when no appropriate verbs are available. I will also omit the context following the cluster (consonant, pause, or vowel). When a cluster is said to simplify, it can be infered that this is possible in all contexts.

Additional examples of final approximant deletion are provided below:

(57)    DELETION IN VERBS ENDING IN OBSTRUENT+APPROXIMANT:
   a.  FA: $ *livre*   'deliver+PRES'   /livr/   → [liv]
   b.      $ *souffle*   'blow+PRES'   /sufl/   → [sʊf]
   c.  SA: $ *règle*   'solve+PRES'   /rɛgl/   → [rɛg]
   d.      $ *cadre*   'frame+PRES'   /kadr/   → [kaᵁd]

**4.3.2.2. Obstruent-nasal clusters**

Obstruent+nasal clusters are more complex. They do not behave as systematically as obstruent+approximant and other nasal-final ones. Words ending in /-sm/, the only attested fricative+nasal combination, can be divided into at least two categories. First we find words containing the suffix /-ism/ for which there exists a corresponding form ending in the suffix /-ist/ (58). As we will see, final /-st/ clusters consistently lose their final /t/; if /-sm/ also simplifies, forms like *communisme* 'communism' and *communiste* 'communist' become homophonous. The forms in /-ism/ are usually less frequent than those in /-ist/, and pertain to a somewhat higher level of speech. It appears that speakers tend to maintain the distinction between the two corresponding forms by keeping the final /m/ in /-ism/ (while reducing the /-ist/ cluster), but this is by no means an absolute rule.

(58)    WORDS IN /-ism/ WITH A (MORE FREQUENT) CORRESPONDENT IN /-ist/:
   a.  *tourisme*        'tourism'       /turism/    →    ?(?) [turɪs]
   b.  *communisme*    'communism'   /kɔmynism/→    ?(?) [kɔmynɪs]

Other words in /-sm/ include those not ending in the suffix /-ism/ and words ending in /-ism/ for which there is no corresponding form ending in /-ist/ (e.g. *fanatisme* 'fanatism', *vandalisme* 'vandalism'), or for which this form is much rarer (e.g. *catéchisme* 'catechism' vs. *catéchiste* 'catechist') or semantically not in a direct correspondence relation (e.g. *anglicisme* 'Anglicism' vs. *angliciste* 'Anglicist'). Here we observe no or little incentive to maintain a contrast between the /-sm/ form and another form in the paradigm. In this heterogeneous category, words have very distinct behaviors, depending in part on their frequency. Deletion of the final nasal is generally easy in common words, although not quite as automatic as in the obstruent+approximant group. Only two reasonably common verbs could be found: *fantasmer* 'to have fantasies' (59f) and *enthousiasmer* 'enthuse' (59g).

(59)    WORDS IN /-ism/ WITHOUT A (MORE FREQUENT) CORRESPONDENT IN /-ist/:
   a.  *rhumatisme*           'rhumatism'           /rymatism/ →    [rymatɪs]
   b.  *orgasme*              'orgasm'              /ɔrgasm/    →    [ɔrgas]
   c.  *organisme*           'organism'            /ɔrganism/ →    [ɔrganɪs]
   d.  *catéchisme*          'catechism'           /kateʃism/ →    [kateʃɪs]
   e.  *anglicisme*          'Anglicism'           /ãglisism/ →    [ãglisɪs]
   f.  $ *fantasme*          'have fantasies+PRES' /fãtasm/   →    ? [fãtas]
   g.  $ *enthousiasme*      'enthuse+PRES'        /ãtuzjasm/ →    ? [ãtuzjas]
   h.  *asthme*              'asthma'              /asm/      →    ? [as]
   i.  *schisme*             'schism'              /ʃism/     →    ?? [ʃɪs]

As for stop+nasal clusters, they appear in very few words and deletion here seems to be highly lexically determined. Whereas *rythme* (60a) rather easily loses its /m/[19], the final nasal of more learned words such as *dogme* (60b) and *énigme* (60c) does not usually drop. But, according to Pupier and Drapeau (1973: 135), it can delete in *diaphragme* (60d). The small number of words in this category and their character make it hard to draw clear conclusions.

(60)    WORDS ENDING IN STOP+NASAL:
   a.  $ *rythme*       'put rhythm+PRES'   /ritm/      →    [rit]
   b.  *dogme*          'dogma'             /dɔgm/      →    * [dɔg]
   c.  *énigme*         'enigma'            /enigm/     →    ?? [enɪg]
   d.  *diaphragme*     'diaphragm'         /diafragm/  →    [diafrag]

The majority of words ending in an obstruent+nasal cluster are usually associated with elevated registers, which are themselves associated with a higher rate of cluster retention. This factor may play a role in the behavior of these words. However, the fact that obstruent+nasal clusters do not simplify as easily as obstruent+approximant ones cannot reduce to register differences. Other clusters are rarer than obstruent+nasal ones and part of the same register - for example /-mn/ - and yet simplify almost automatically. This indicates that a phonological factor is also at play here.

**4.3.2.3. Nasal-approximant clusters**

I have found only one example containing a final nasal+approximant sequence (61). /ʒyml/ is the non-standard present form of the verb *jumeler* [ʒymle] 'to pair, to twin' (the normative one being *jumelle* [ʒymɛl]).[20] When the final cluster /-ml/ arises, the final /l/ is easily dropped in the output. But this being the only relevant form, it is hard to draw any generalization on the behavior of this cluster.[21]

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[19]This judgment agrees with the one given by Pupier & Drapeau (1973), but Thériault (2000) considers deletion to be impossible in this form, which might reflect a change in progress.

[20]The [ɛ] in the present form alternates with Ø in the infinitive (a reflex of an historic schwa, indicated by the written <e>), on the model of *appeler* [apl+e] 'to call' vs. *appelle* [apɛl] 'call, present'. These verbs are analyzed in present-day French as having two stems, e.g. [ʒyml-] and [ʒymɛl-] or [apl-] and [apɛl-] (see Morin 1988). The exact contexts in which each of these stems is used are not of interest here; it suffices to know that the /ɛ/-less one, found in particular in the infinitive and past participle, tends to generalize in non-formal registers in less frequent verbs, and replace the /ɛ/-stem in forms in which the norm prescribes its use, notably in the present tense (singular and 3rd plural). Hence [ʒyml] rather than [ʒymɛl].

[21]We will see that /-lm/ final clusters are also simplified. There are therefore two possible motivations for the deletion of /l/ in /ʒyml/: the SSP and the avoidance of sequences composed of a lateral and a nasal.

I will simply observe that deletion in this unique form is consistent with how SSP violations are treated in other sequences (obstruent+approximant and obstruent+nasal ones).

(61)    NASAL+APPROXIMANT CLUSTER:
        NL:    $ *"jumele"*    'pair, twin+PRES'    /ʒyml/    →    [ʒʏm]

### 4.3.2.4. Analysis

On the whole, then, the facts may be characterized as follows: final consonant deletion is highly variable in obstruent+nasal clusters but almost obligatory in obstruent+approximant ones. In both cases, as well as in the only nasal+approximant example, I assume that deletion is motivated by the SSP. The difference between obstruent+approximant and obstruent+nasal sequences follows naturally from the assumption that sonority violations are relative. So the formulation of the SSP and the corresponding constraints should be modified accordingly.

Let us attach a numerical value to each category of consonants in the sonority hierarchy: glides=3 > liquids=2 > nasals=1 > obstruents=0, as is done in Clements (1990). The SSP bans elements that correspond to sonority maxima in the string of segments, but that are not permissible sonority peaks (generally only vowels are). In other words, it states that segments that are not sonority peaks should not have a higher sonority value than all their adjacent segments. For example, the sequence [mls] violates the SSP because [l], not a sonority peak, has a higher sonority value than both [m] and [s]. Equivalently, the difference in sonority value between a non-peak (a consonant) and each of its adjacent segments should not be strictly positive. Taking [mls] again, the difference between [l] and [m] is 2-1=1, that between [l] and [s] is 2-0=2. Both differences are strictly positive, in violation of the SSP. We can compare [mls] with the sequence [lms], which does not violate the SSP. [m] is not more sonorous than [l]. The difference in sonority value between [m] and [l] is 1-2=-1, that between [m] and [s] is 1-0=1; at least one difference is not positive, so the SSP is not violated. Notice that a sequence of two consonants flanked by a vowel on both sides never violates the SSP, since each consonant is necessarily adjacent to at least one segment, the vowel, that is more sonorous than it. The SSP can only be violated in internal sequences of three or more consonants, or in clusters of two consonants at domain edges (where the edge consonant is not adjacent to a vowel).

Violations of the SSP may be relativized by considering the magnitude of the sonority differences between a segment and its neighbors: the lower they are

(provided they are positive), the milder the sonority violation, and the lower-ranked the corresponding constraint. If a consonant is flanked by a consonant on both sides, I take the higher of the two sonority differences to be relevant. This is expressed in the definition in (62a), which projects a family of SSP constraints, inherently ranked as in (62b).

(62)    SONORITY SEQUENCING PRINCIPLE (revised formulation):
        a.  SSP (n):
            Let  Y be a segment that is not a possible sonority peak (i.e. not a vowel),
                 X (and Z) its adjacent segment(s)
                 S(Y), S(X) (and S(Z)) their respective sonority value
                 S(Y), S(X) (and S(Z)) are not such that S(Y)-S(X)=n>0 (and 0<S(Y)-S(Z)<n)
        b.  SSP (n) >> SSP (n')      iff n>n'

The general constraint in (62a) simply states that the highest sonority difference between a consonant and its adjacent segments should not be equal to *n*, with all sonority differences being strictly positive. Notice that this definition of the SSP allows sonority plateaus. The cluster [mls], for instance, violates SSP(2): 2 corresponds to the sonority difference between [l] and [s], which is higher than that between [l] and [m], both being positive. The cluster [mln] would violate only SSP(1). This sequence incurs a milder violation of the SSP than [mls], which is expressed by the inherent ranking SSP(2) >> SSP(1), derived from (62b). As for the cluster [mrs], it violates SSP(3), since I consider /r/ to be a glide with a sonority value of 3. When a consonant appears domain-initially or -finally, only one sonority difference can be computed; it is it that determines whether the SSP is violated and at what level. This is the situation we find in QF.

Let us apply this proposal to QF word-final clusters. We get a SSP violation if the last consonant has a higher sonority value than its preceding consonant. In obstruent+/l/ clusters (64b) the difference in sonority between the liquid and the obstruent is 2-0=2. These clusters violate SSP(2). In obstruent+/r/ ones (64a), the sonority difference is 3-0=3, in violation of SSP(3). In obstruent+nasal sequences (64c) the difference between the nasal and the preceding consonant is 1-0=1. Only SSP(1) is violated. I assume that final consonant deletion is categorical in obstruent+approximant clusters but variable in obstruent+nasal ones. These results are generated by the rankings in (63). The rankings in (63a-b) are fixed (see (62b) above and section 3.2.3). The one in (63c) ensures that it is the final consonant and not the postvocalic one that deletes in a two-consonant cluster. It is the QF-specific rankings in (63c-d) that drive consonant deletion in final clusters of increasing sonority. Omission of the final consonant violates MAX-C(-stop) (29b in chapter 3)

rather than simply Max-C since the deleted final consonant is never a stop when the SSP is violated. The ranking in (63c) follows from the categorical nature of simplification when SSP(2) (or SSP(3)) is violated. Max-C(-stop) and SSP(1) are unranked with respect to each other. This indeterminacy yields the variable consonant deletion in obstruent+nasal sequences. Since the deletion of final non-stops is prefered over that of postvocalic consonants, including stops, the ranking in (63d) is also established. This is illustrated in the tableau in (64).

(63)    RANKINGS WITH RESPECT TO THE SSP:
        a.  SSP (3) >> SSP (2) >> SSP (1)
        b.  Max-C/V__ >> Max-C
        c.  SSP (2) >> Max-C(-stop)
        d.  Max-C/V__ >> Max-C(-stop)

(64)    DELETION IN FINAL CLUSTERS OF INCREASING SONORITY:

| a. /O+r/ /livr/ | Max-C/V__ | SSP (3) | SSP (2) | Max-C(-stop) | SSP (1) |
|---|---|---|---|---|---|
| -Or   [livr] | | *! | | | |
| →-O   [liv] | | | | * | |
| -r    [lir] | *! | | | | |
| b. /O+l/ /sufl/ | | | | | |
| -Ol   [sufl] | | | *! | | |
| →-O   [suf] | | | | * | |
| -l    [sul] | *! | | | | |
| c. /O+N/ /ritm/ vs./dɔgm/ | | | | | |
| →-ON [rɪtm] [dɔgm] | | | | | * |
| →-O [rɪt] *[dɔg] | | | | * | |
| -N *[rɪm] *[dɔm] | *! | | | | |

## 4.3.3. CLUSTER REDUCTION AND PERCEPTUAL SALIENCE

QF has a fairly complex pattern of cluster simplification when sonority is not violated. But two crucial factors can easily be identified. QF displays the familiar contrast between stops and other consonants, stops deleting in a wider range of contexts. Stops in cluster-final position drop after all types of consonants except /r/, whereas other consonants delete only in restricted contexts, when adjacent to very similar segments. It is then useful to study stop-final and non-stop-final clusters separately. Abstracting away from the stop/non-stop opposition, whether deletion takes place or not is determined by the amount of contrast between the final

consonant and the preceding one. One specific category of consonants, however, never delete: those that follow an /r/.

### 4.3.3.1. Data

4.3.3.1.1. /r/-initial clusters

/r/+C clusters are unaffected by final consonant deletion. They comprise the sequences /-rl/ (65), /r/+nasal (66), /r/+fricative (67), and /r/+stop (68).

(65)    /-rl/ CLUSTERS:
        a.  $ *parle*        'speak+PRES'       /parl/      →   [parl] *[par]
        b.  $ *déferle*      'unfurl+PRES'      /defɛrl/    →   [defɛrl] *[defɛr]

(66)    /r/+NASAL CLUSTERS:
        a.  $ *ferme*        'close+PRES'       /fɛrm/      →   [fɛrm] *[fɛr]
        b.  $ *incarne*      'incarnate+PRES'   /ẽkarn/     →   [ẽkarn] *[ẽkar]
        c.  $ *épargne*      'save+PRES'        /eparɲ/     →   [eparɲ] *[epar]

(67)    /r/+FRICATIVE CLUSTERS:
        a.  $ *énerve*       'enervate+PRES'    /enɛrv/     →   [enɛrv] *[enɛr]
        b.  *amorphe*        'flabby+PRES'      /amɔrf/     →   [amɔrf] *[amɔr]
        c.  *quatorze*       'fourteen'         /katɔrz/    →   [katɔrz] *[katɔr]
        d.  $ *berce*        'rock+PRES'        /bɛrs/      →   [bɛrs] *[bɛr]
        e.  $ *émerge*       'emerge+PRES'      /emɛrʒ/     →   [emɛrʒ] *[emɛr]
        f.  $ *cherche*      'look for+PRES'    /ʃɛrʃ/      →   [ʃɛrʃ] *[ʃɛr]

(68)    /r/+STOP CLUSTERS:
        a.  $ *courbe*       'curve+PRES'       /kurb/      →   [kurb] *[kur]
        b.  $ *usurpe*       'usurp+PRES'       /yzyrp/     →   [yzyrp] *[yzyr]
        c.  $ *accorde*      'grant+PRES'       /akɔrd/     →   [akɔrd] *[akɔr]
        d.  $ *apporte*      'bring+PRES'       /apɔrt/     →   [apɔrt] *[apɔr]
        e.  $ *nargue*       'flout+PRES'       /narg/      →   [narg] *[nar]
        f.  $ *marque*       'mark+PRES'        /mark/      →   [mark] *[mar]

Postvocalic /r/, however, is subject to a vocalization/deletion process whereby it becomes a vocalic offglide, which may even reduce to nothing. This is true both when /r/ is in absolute word-final position (69a) and when it is followed by a consonant (69b). I interpret this process as resulting from the merger of /r/ with the preceding vowel, not its deletion. This phenomenon provides support for

the classification of /r/ as a glide in this position. It interacts with cluster simplification by effectively reducing the cluster to a single consonant, but is independent of it since it applies also when no cluster is present. /r/-vocalization and final consonant deletion are two distinct processes that I will keep separate. Below I will also extend the vocalization process to /l/.

(69)  POSTVOCALIC /r/ VOCALIZATION:
 a.  *port*   'harbor'   /pɔr/  → [pɔʷ]
   *pire*   'worse'   /pir/  → [piʲ]
 b.  *porte*   'door'   /pɔrt/  → [pɔᵊt]
   *parle*   'speak+PRES' /parl/  → [pæl]

Notice that /r/-vocalization is a sociolinguistically marked process, which may not be shared by all speakers of QF. I will however make the simplifying assumption that it is generally available and optional.

4.3.3.1.2. Other clusters not ending in a stop

These clusters can be grouped into three categories. The largest category comprises all the clusters that are never simplified: approximant+fricative, nasal+fricative, and stop+fricative. Two clusters are reduced by deletion of the second consonant: nasal+nasal and fricative+fricative. Finally, the cluster /-lm/ is exceptional in that it is simplified by the omission of the non-final liquid. I review each of these groups in turn.

The situation for all fricative-final clusters with the exception of fricative+fricative ones is rather simple. Liquid+fricative (70), nasal+fricative (71) and stop+fricative (72) clusters always surface intact.[22]

(70)  LIQUID+FRICATIVE CLUSTERS:
 a.  $ *valse* 'waltz+PRES'  /vals/  → [vals] *[val]
 b.  *belge*  'Belgian'   /bɛlʒ /  → [bɛlʒ] *[bɛl]

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[22]In the following two words the final fricative may be omitted:
(i) *biceps* 'biceps'    /bisɛps/  → [bisɛp(s)]
  *chips* 'potato chips'  /tʃips/  → [tʃɪp(s)]
I think that these words in fact do not illustrate the phonological deletion of a fricative, but a morphological analysis in which the final *s* is interpreted as a plural marker, which is not normally pronounced in French. It is worth noting that these words are almost exclusively used in the plural, and the last one is indeed an English borrowing that contains a plural marker.

(71)  NASAL+FRICATIVE CLUSTERS:
 a.  $ *lunche* 'have a snack+PRES' /lɔnʃ / → [lɔnʃ] *[lɔn]
 b.  *Banff*  (town)     /banf/ → [banf] *[ban] *[bam][23]
 c.  (Mercedes) *Benz*     /bɛnz/ → [bɛnz] *[bɛn]

(72)  STOP+FRICATIVE CLUSTERS:
 a.  $ *boxe* 'do boxing+PRES' /bɔks/  → [bɔks] *[bɔk]
 b.  *laps*  'lapse'    /laps/  → [laps] *[lap]
 c.  *ersatz* 'ersatz'   /ɛrzats/ → [ɛrzats] *[ɛrzat]

Nasal+nasal and fricative+fricative clusters regularly lose their final consonant in all words, admittedly few, that end in one of these underlying sequences.

(73)  NASAL+NASAL CLUSTERS:
 a.  *hymne*  'hymn'  /imn/  → [ɪm]
 b.  *indemne* 'safe'  /ẽdɛmn/ → [ẽdɛm]

(74)  FRICATIVE+FRICATIVE CLUSTERS:
 *Reeves*         ⇒ [riv]

The example in (74), unfortunately the only one I have found of this type, deserves a few comments. First, this example of fricative deletion is important because it has previously been assumed that fricatives, unlike approximants, nasals and stops, never delete in final clusters. This generalization was proposed by Pupier & Drapeau (1973), and subsequently adopted by Kemp, Pupier & Yaeger (1980), Nikièma (1998), and Thériault (2000). It was based on the behavior of fricatives after consonants other than fricatives, like those in (70)-(72), but fricative+fricative clusters were not considered by these authors since they cannot be found in general French, in both the native and borrowed lexicon. But if we examine the pronunciation of (originally) English names by QF speakers, we note that the one I have found that ends in a fricative+fricative cluster loses its final consonant (74). This example is unexpected according to the generalization that fricatives never delete, but it is predicted in the contrast- and perception-based approach developed here. Note that the relation between the English and QF forms is not that between an underlying and a surface representation. This is why I adopt a different notation in the case of borrowings, which I will use throughout the discussion on QF. The pronunciation in QF is given in square brackets; I use double arrows to represent the adaptation process in the receiving language.

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[23]This word may also be pronounced [bãf] with deletion of the nasal consonant and transfer of the nasality onto the preceding vowel. See also the examples in (85)-(87).

Finally, the cluster /-lm/, the only non-/r/-initial sonorant combination, is exceptional in that it is the /l/ that disappears rather than the final nasal (75). No other clusters, including the other /l/-initial ones, may lose a non-final consonant.

(75)   /-lm/ CLUSTERS:
   a.  $ *filme*      'film+PRES'      /film/     →     [fɪ(:)m]
   b.  $ *calme*      'calm+PRES'      /kalm/     →     [ka(:)m]

I suggest that these forms involve not the deletion of /l/ but, as in the case of /r/ above, its merging with the preceding vowel. In support of this interpretation, I notice that the vowels in (75) are optionally lengthened. Lengthening, however, is impossible in similar forms not containing an underlying liquid. Consider in this respect the following pair of sentences.

(76)   OPTIONAL LENGTHENING WITH /l/ DELETION:
   a.  *Les enfants sont calmes*          /... kalm/   →    [... ka(:)m]
       'The children are calm'
   b.  *J'ai acheté une CAM*              /... kam/    →    [... kam] *[ka:m]
       'I bought a CAM (Carte-Autobus-Métro = pass for public transportation)'

Unlike /r/-vocalization, however, /l/-vocalization is not generally available in postvocalic position. We can make sense of this distinction if we assume that the more sonorous or vowel-like the consonant, the more easily it fuses with the preceding vowel. /r/ being higher in the sonority hierarchy, it vocalizes quite freely, whereas /l/-vocalization is limited to contexts where it is needed to avoid marked clusters, here combinations of laterals and nasals /lm/. I will get back to this contrast in the analysis in section 4.3.3.2.

4.3.3.1.3. Other clusters ending in a stop

The final category we have to consider comprises stop-final clusters. These are more complicated and necessitate an elaborate discussion. In particular, clusters differ on whether they display lexical effects in the cluster reduction process. Some sequences may be simplified (and most generally are) in all the words ending in the relevant combination. For other clusters, however, deletion is lexically determined, being possible for only a subset of the words. This contrast was also observed for obstruent+approximant vs. obstruent+nasal final sequences. Relevant factors in these lexical effects include frequency and register: the more frequent and the less learned a word, the more likely it is to get simplified. I consider this lexical variability

to be a property of the clusters themselves, because the clusters that do not display any lexical variation are always reduceable, irrespective of the frequency, register, etc. of the word.

Stops can appear after all types of consonants, in addition to /r/ (see section 4.3.3.1.1.): /l/, nasals, fricatives, and stops. Stop+stop clusters are easily simplified in all the relevant words:

(77)   STOP+STOP CLUSTERS:
/-pt/:  a.  $ *adopte*       'adopt+PRES'     /adɔpt/     →    [adɔp]
        b.  $ *capte*        'capt+PRES'      /kapt/      →    [kap]
        c.  $ *accepte*      'accept+PRES'    /aksɛpt/    →    [aksɛp]
/-kt/:  d.  $ *"paquete"*[24]  'pack+PRES'      /pakt/      →    [pak]
        e.  $ *concocte*     'concoct+PRES'   /kɔ̃kɔkt/    →    [kɔ̃kɔk]
        f.  $ *collecte*     'collect+PRES'   /kɔlɛkt/    →    [kɔlɛk]

Unlike stop+stop clusters, fricative+stop, nasal+stop, and /l/+stop ones must be broken down into more specific categories. Among fricative+stop clusters, /-st/ should be distinguished from /-sp/, /-sk/, and /-ft/. /-st/ final clusters are quite systematically reduced, without distinctions among different lexical items (78).[25] They behave like the stop+stop clusters above.

(78)   /-st/ CLUSTERS:
   a.  $ *existe*       'exist+PRES'        /ɛgzist/     →     [ɛgzɪs]
   b.  $ *poste*        'mail+PRES'         /pɔst/       →     [pɔs]
   c.  $ *reste*        'stay+PRES'         /rɛst/       →     [rɛs]

By contrast, final deletion in /-sp/, /-sk/, and /-ft/ applies freely in some lexical items but is blocked or clearly disfavored in others. Compare the words in (79a) vs. (79b) for /-sp/, (80a-c) vs. (80d-f) for /-sk/,[26] and (81a-d) vs. (81e) for

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[24]This is the present form of infinitive *paqueter*, a (non-standard) verb related to *paquet* 'parcel'. The form that could be expected according to the standard paradigm is *paquette* [pakɛt]; this form is totally impossible. See the form "*jumele*" in (61) and the related footnote.
[25]Pupier & Drapeau (1973) mention that stop deletion after fricatives is accompanied by compensatory lengthening of the fricative. This claim requires further investigation, as I do not see any systematic difference between underlyingly word-final fricatives and word-final fricatives derived by cluster reduction.
[26]*Presque* 'almost' /prɛsk/ and *jusque* 'until, up to' /ʒysk/ could be added to the list of non-simplifiable words. But these two words are exceptional in QF in that they trigger schwa insertion when followed by a consonant-initial word, e.g. *presque partout* 'almost everywhere' /prɛsk partu/ → [prɛskəpartu]. Unlike better known European varieties of French, such as that described in chapter 2, QF does not generally allow schwa insertion between words, except in clitic groups.

/-ft/. The cluster /-ft/ does not occur in the native French lexicon and is found only in loanwords from English. As we will see in more detail below, the greater likelihood of deletion in /sp, sk, ft/ as opposed to /st/ follows from the amount of contrast within the cluster.

(79)    /-sp/ CLUSTERS:
    a. *Deraspe*        (proper name)        /dœrasp/    →    [dœras]²⁷
    b. $ *crispe*        'shrivel+PRES'        /krisp/    →    ?? [krɪs]

(80)    /-sk/ CLUSTERS:
    a. *casque*        'cap'                /kask/    →    [kas]
    b. *disque*        'disk'                /disk/    →    [dɪs]
    c. $ *risque*        'risk+PRES'            /risk/    →    [rɪs]
    d. $ *masque*        'mask+PRES'            /mask/    →    ?? [mas]
    e. $ *brusque*        'be brusk+PRES'        /brysk/    →    ?? [brys]
    f. *fisc*            'Treasury'            /fisk/    →    * [fɪs]

(81)    /-ft/ CLUSTERS:
    a. *draft*            ⇒    [draf]
    b. *lift*            ⇒    [lɪf]
    c. *Kraft* (food company)    ⇒    [kraf]
    d. *shift*            ⇒    [ʃɪf]²⁸
    e. *loft*            ⇒    ?(?) [lɔf]

Nasal+stop clusters are found only in borrowings from English. They are always homorganic, but the final stop may be voiced or voiceless. Clusters with a voiced stop²⁹ may always be simplified (82), whereas the behavior of clusters with a

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²⁷Interestingly, this name is also often pronounced [dœraps], with metathesis of /p/ and /s/, which allows the retention of both consonants. But metathesis is not a productive phenomenon in QF, unlike the Lithuanian and Singapore English cases mentioned in the appendix to chapter 3.

²⁸Interestingly, this word is often reanalyzed as *chiffre* 'number' /ʃifr/, also normally pronounced [ʃif]. So in hypercorrected speech, the pronunciation [ʃifr] for *shift* can be heard.

²⁹The only cluster with a voiced stop is /-nd/, since English does not have words ending in [ŋg] and [mb]. Some words spelled <-Vng> are pronounced [Vɲ] in QF and either [Vɲ] or [∇g] in European varieties, but there is no reason to believe that there is a final cluster /ŋg/ in the underlying representation of these forms. The pronunciation with the final stop is probably orthographic.

(i)    a.    *ping pong*        QF: [pɪɲpɔɲ]    EF: [piɲpɔ̃g]
    b.    *big bang*        QF: [bɪgbaɲ]    EF: [bigbãg]
    c.    *gang*            QF: [gaɲ]        EF: [gãg]
    d.    *jogging*        QF: [dʒɔgɪɲ]    EF: [dʒɔgiɲ]

voiceless stop is more variable, here again depending on the lexical item. Forms with a deletable final stop are given in (83), others with a stable cluster appear in (84).

(82)    /-nd/ CLUSTERS:
    a. *weekend*            ⇒    [wikɛn]
    b. *band*            ⇒    [ban]
    c. *stand* (Noun)        ⇒    [stan]
    d. *blind* (Noun)        ⇒    [blan]

(83)    /-mp, -nt, -ŋk/ CLUSTERS WITH STOP DELETION:
    a. *pimp*            ⇒    [pɪm]
    b. *cent*            ⇒    [sɛn]
    c. *peppermint*        ⇒    [papœrman] / [paparman]
    d. *drink* (Noun)        ⇒    [drɪɲ]
    e. *sink* (Noun)        ⇒    [sɪɲ]
    f. *lipsync*            ⇒    [lɪpsɪɲ]
    g. *skunk*            ⇒    [skɔɲ]        (Bergeron 1980)

(84)    /-mp, -nt, -ŋk/ CLUSTERS WITH STOP RETENTION:
    a. $ *bump* (N. and V.)    ⇒    [bɔmp], * [bɔm]    (infin. [bɔmp+e])
    b. $ *jump* (N. and V.)    ⇒    [dʒɔmp], * [dʒɔm]    (infin. [dʒɔmp+e])
    c. $ *sprint* (N. and V.)    ⇒    [sprɪnt], ?? [sprɪn]    (infin. [spint+e])
    d. $ *bunt* (V.)        ⇒    [bɔnt], * [bɔn]    (infin. [bɔnt+e])
    e. *punk*            ⇒    [pɔɲk], * [pɔɲ]
    f. $ *dunk* (V.)        ⇒    [dɔɲk], * [dɔɲ]    (infin. [dɔɲk+e])

There is another strategy available when borrowing words ending in a nasal+stop cluster, which consists in nasalizing the preceding vowel, with concomitant loss of the nasal consonant. The result contains a single word-final stop, and no cluster to simplify. This process was frequent in the adaptation of old borrowings but seems to be no longer productive. So I do not take it to be part of the synchronic grammar of QF.

(85)    /-nd/ CLUSTERS WITH VOWEL NASALIZATION:
    a. *band*            ⇒    [bẽd]        (Bergeron 1980)
    b. *stand* (N.)        ⇒    [stẽd]        (Bergeron 1980)

(86)   /-mp, -nt, -ŋk/ CLUSTERS WITH VOWEL NASALIZATION:

    a.   *dump* (N. and V)                ⇒    [dɔ̃p]

    b.   *swamp*                        ⇒    [swɔ̃p]

    c.   *tramp*                        ⇒    [trẽp]         (Rogers 1977)

    d.   *stamp*                        ⇒    [stẽp]         (Bergeron 1980)

    e.   *bunk*                         ⇒    [bɔ̃k]         (Bergeron 1980)

    f.   *crank* (N. and V.)          ⇒    [krẽk]         (Gendron 1967)

    g.   *skunk*                       ⇒    [skɔ̃k]         (Bergeron 1980)

For some words both simplification strategies are used: *band*, *stand*, and *skunk* are attested with final deletion in (82b-c) and (83g) and nasalization in (85) and (86g). For some words ending in a voiceless stop, the final cluster may be retained or reduced by nasalization (87). The two forms in (87a) coexist in Québec with the same meaning.[30] The example in (87b) is more interesting since the forms have two different meanings, both corresponding to the English *tank*: The form with the cluster [taŋk] and the simplified one with a low nasal vowel [tãk] refer to the military vehicle,[31] whereas the form with a mid nasal vowel corresponds to the container in a car for holding gas. The verb *tinquer* /tẽk+e/ 'tank up+INF', always pronounced [tẽke], derives from this last form. Notice that the nasal vowel in this verb is stable throughout the paradigm and is not "undone" when a vowel-initial suffix is added. That is, we do not get [tẽk] for the noun or the bare form of the verb and *[taŋke] or *[tẽŋke] with the infinitive suffix /-e/, even though these forms are phonotactically perfectly acceptable, e.g. in *bingo* 'bingo' [bıŋgo], *caneton* 'young duck' [kantɔ̃], or *camping* [kampıɲ]. The same holds for the verbs *dumper* [dɔ̃pe] and *cranker* [krẽke], derived from *dump* and *crank* in (86a and 86f). This suggests that the nasal vowel is present in the underlying representation.

(87)   /-mp, -nt, -ɲk/ CLUSTERS WITH STOP RETENTION OR VOWEL NASALIZATION:

    a.   *jump*      ⇒    [dʒɔmp] / [dʒɔ̃p]

    b.   *tank*       ⇒    military vehicle:    [taŋk] / [tãk]

                                   container for gas:    [tẽk]

Finally, the liquid /l/, like /r/ in section 4.3.3.1.1, can be followed by any stop /d, t, b, p, g, k/. The final stop fails to delete in all of these combinations, with the

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notable exception of the cluster /-ld/. The examples in (88) illustrate the retention of the two consonants in /l/+stop clusters other than /-ld/.

(88)   /l/+STOP CLUSTERS OTHER THAN /-ld/:

| | | | | | | |
|---|---|---|---|---|---|---|
| /-lt/: | a. | $ *révolte* | 'revolt+PRES' | /revɔlt/ | → | [revɔlt] |
| | b. | $ *"pellete"* | 'shovel+PRES' | /pɛlt/ | → | [pɛlt][32] |
| | c. | $ *insulte* | 'insult+PRES' | /ẽsylt/ | → | [ẽsylt] |
| /-lb/: | d. | *bulbe* | 'bulb' | /bylb/ | → | [bylb] |
| /-lp/: | e. | $ *disculpe* | 'exculpate+PRES' | /diskylp/ | → | [diskʊlp] |
| | f. | $ *palpe* | 'touch+PRES' | /palp/ | → | [palp] |
| /-lg/: | g. | *algue* | 'seaweed' | /alg/ | → | [alg] |
| | h. | $ *divulgue* | 'divulge+PRSE' | /divylg/ | → | [divʏlg] |
| /-lk/: | i. | $ *calque* | 'make a tracing+PRES' | /kalk/ | → | [kalk][33] |

Some words ending in /-ld/ behave like those in (88) and always retain their final cluster (89). But many other words behave differently and may lose their final stop, in particular proper names (90) and borrowings from English (91).

(89)   /-ld/ CLUSTERS WITH STOP RETENTION:

    a.   $ *solde*         'put on sale+PRES'    /sɔld/    →    [sɔld] *[sɔl]

    b.   *tilde*            'tilde'               /tild/    →    [tıld] *[tıl]

(90)   /-ld/ CLUSTERS WITH STOP DELETION – PROPER NAMES:

    a.   *Léopold*      (first name)    /leopɔld/    →    [leopɔl] / [leɔpɔl]

    b.   *Donald*       (first name)    /donald/    →    [donal]

    c.   *Romuald*    (first name)    /rɔmyald/    →    [rɔmyal]

    d.   *Raynald*     (first name)    /renald/    →    [renal]

(91)   /-ld/ CLUSTERS WITH STOP DELETION – LOANWORDS:

    a.   (Glenn) *Gould*                ⇒    [guːl] / [gʊl]

    b.   *windshield*                   ⇒    [wınʃiːl]

    c.   *McDonald*    (fast food chain)    ⇒    [makdonal] / [makdɔnal]

The most interesting example attesting to the deletion of the final /d/ is the one in (90a). The name *Léopold* has often been confused with *Léo-Paul*, which has never contained a final /d/. Both spellings have been used to refer to the same

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[30]The two forms may be regional variants. The Montréal speakers I know use the form with the cluster, whereas others from (ville de) Québec prefer the reduced one.

[31]The form with the cluster is native to Québec, whereas I believe that the one with a low nasal vowel is a borrowing from the standard pronunciation used in Europe.

[32]Again, [pɛlt] is a reanalyzed form of an earlier [pɛlɛt]. See examples (61) and (77d) and the corresponding footnotes.

[33]Note that the common word *quelque* 'some' is usually pronounced [kɛk] in QF and does not seem to have a cluster in its underlying representation.

individual, as can be seen in genealogical documents, and a statistical study of Christian names given in Québec simply considers them to be two variants of the same name (Duchesne 1997).

The possibility of stop deletion after /l/ is noteworthy since it was assumed by Pupier and Drapeau (1973), Kemp, Pupier & Yaeger (1980), Walker (1984), Nikièma (1998), Papen (1998), and Thériault (2000) that nothing could drop after a liquid, so that all liquid+stop clusters were stable. This generalization was established on the basis of words such as those in (88) and (89), but these authors did not consider the items in (90) and (91).

4.3.3.1.4. Synthesis

It is now time to synthesize all the data given so far, which yield a very complex pattern. The clusters that do not violate the SSP can be divided into three categories, based on whether cluster simplification is possible and whether it displays lexical effects. The first category comprises clusters which may be reduced in all lexical items (class 1). The second category includes clusters that can be simplified only in a subset of the relevant lexical items (class 2). The clusters that are always retained form the third category (class 3). Simplification is achieved by deletion of the final consonant in all cases but one; in the cluster /-lm/ the lateral merges with the preceding vowel. I disregard at this point the possibility of vocalization of /r/, whose application extends beyond cluster simplification.

The clusters in each of these categories are given in (92):

(92)    CLASS 1. REDUCTION POSSIBLE FOR ALL LEXICAL ITEMS:

1. /-vz/:    *Reeves*                                    ⇒    [ri:v]
2. /-mn/:   *hymne*     'hymn'         /imn/      →    [ɪm]
3. /-lm/:   $*calme*    'calm+PRES'    /kalm/     →    [kam]
4. Stop+Stop clusters:
   /-pt/:   $*accepte*   'accept+PRES'  /aksɛpt/   →    [aksɛp]

   /-kt/:   $*collecte*  'collect+PRES' /kɔlɛkt/   →    [kɔlɛk]
5. /-st/:   $*existe*    'exist+PRES'   /ɛgzist/   →    [ɛgzis]
6. /-nd/:   *band*                                       ⇒    [ban]

CLASS 2. REDUCTION POSSIBLE FOR A SUBSET OF LEXICAL ITEMS:

1. /-ld/:   *Léopold*    (name)         /leopɔld/  →    [leopɔl]
   vs.      $*solde*     'put on sale+PR' /sɔld/   →    * [sɔl]

2. /-sp/, /-sk/, and /-ft/ clusters:

/-sp/:   *Deraspe*    (name)         /dœrasp/   →    [dœras]
vs.      $*crispe*    'shrivel+PRES' /krisp/    →    ?? [krɪs]
/-sk/:   *casque*     'cap'          /kask/     →    [kas]
vs.      *masque*     'mask'         /mask/     →    ?? [mas]
/-ft/:   *draft*                                    ⇒    [draf]
vs.      *loft*                                     ⇒    ?(?) [lɔf]

3. /-nt/, /-mp/, and /-ɲk/ clusters:

/-nt/:   *cent*                                    ⇒    [sɛn]
vs.      *sprint*                                   ⇒    ?? [sprɪn]
/-mp/    *pimp*                                     ⇒    [pɪm]
vs.      *djompe*                                   ⇒    * [dʒɔm]
/-ɲk/    *drink* (Noun)                             ⇒    [drɪŋ]
vs.      *punk*                                     ⇒    * [pɔɲ]

CLASS 3. NO REDUCTION:
1. All /r/-initial clusters
2. All /l/-initial clusters, except /-ld/
3. All fricative-final clusters, except /-vz/

The results may be characterized in a more compact way, but it is useful for that purpose to establish the feature specifications I adopt for the QF consonants. These consonants are given in (93) by manner of articulation, place of articulation, and, for obstruents, voicing. I only give the glide version of /r/, which is the relevant one in this analysis. I put /r/ in the uvular category, even though it is not the only articulation of this sound in Québec. Place of articulation for the rhotic is irrelevant in the analysis to come.

(93)    CONSONANT INVENTORY IN QUÉBEC FRENCH:

|            |      | Labial | Coronal | Palatal/velar | Uvular |
|------------|------|--------|---------|---------------|--------|
| Stops      | -vc  | p      | t       | k             |        |
|            | +vc  | b      | d       | g             |        |
| Fricatives | -vc  | f      | s    ʃ  |               |        |
|            | +vc  | v      | z    ʒ  |               |        |
| Nasals     |      | m      | n       | ɲ             |        |
| Liquids    |      |        | l       |               |        |
| Glides     |      | w      |         | j ɥ           | r      |

To express voicing and place contrasts I use the standard features [voice], [labial], [coronal], and [velar]. The uvular place of articulation of the rhotic plays no role and I leave it aside. For manner of articulation, as mentioned in the preceding chapters, I use Clements's (1990) major class features [sonorant], [approximant], and [vocoid], with the specifications given in (94). To distinguish between stops and fricatives, I use a feature [noisy], which is specified only for obstruents.

(94)    CONSONANT SPECIFICATIONS FOR MANNER OF ARTICULATION FEATURES:

|              | Stops | Fricatives | Nasals | Liquids | Glides |
|--------------|-------|------------|--------|---------|--------|
| Noisy        | –     | +          |        |         |        |
| Sonorant     | –     | –          | +      | +       | +      |
| Approximant  | –     | –          | –      | +       | +      |
| Vocoid       | –     | –          | –      | –       | +      |

The feature [noisy] used here corresponds to an acoustic/auditory version of [continuant], which is defined in articulatory terms. The reason why I make this distinction is the following. So far I have used the feature [continuant] in the context of the generalization that stops prefer to be followed by a [+continuant] segment. The phonetic motivation for it was based on the audibility of the release burst, which is favored if the stop is followed by a segment that does not block the flow of air escaping through the oral cavity. Such segments correspond to the class of [+continuant], defined as the segments that do not involve a total occlusion in the oral cavity. This is obviously an articulatory definition, one that has become standard. It applies to all segments, which are all specified for this feature (not only obstruents), with stop and nasal consonants being unambiguously treated as [-continuant] (the liquids are more controversial, see e.g. van de Weijer 1995; Kaisse 1998). The unification of stops and nasals under the specification [-continuant] has proved useful in many phonological contexts other than the one described here, notably place assimilation among these segments.

Yet in other contexts nasals and other sonorants fail to participate in continuancy distinctions, which are limited to obstruents. Cases of continuancy dissimilation, for instance, involve only obstruents, e.g. in Modern Greek (Kaisse 1988, cited in Rice 1992) or Yucatec Maya (Straight 1976; Lombardi 1990; Padgett 1992).[34] I believe such cases involve an acoustic/perceptual dimension rather than an

articulatory one. Acoustically a major distinguishing factor among consonants is sonorancy, which can be defined according to the presence or absence of formant structure. Obstruents are then characterized by the presence or absence of noise during closure, and this is what the feature [noisy] refers to. This definition excludes sonorants from consideration. To the extent that I consider cluster simplification to be motivated by acoustic/perceptual factors, it is coherent that I use features that refer to meaningful acoustic/perceptual dimensions. Now, if the tension in the use of continuancy based on whether all segments or only obstruents reflect the existence of two quite distinct dimensions, one also expects the corresponding use of two different features.

The feature specifications of French consonants now being established, we can take a different look at the pattern of cluster reduction in QF and propose the generalizations in (95). For the purpose of the formal analysis I will be developing, I suppose that cluster reduction is obligatory for clusters of class 1, optional or variable for clusters of class 2, and prohibited for clusters of class 3.

(95)    GENERALIZATIONS ON FINAL CLUSTER SIMPLIFICATION IN QF:
   a. *General rule*:        /r/-initial clusters never simplify.
                             These are the clusters that contain a contrast in [vocoid].
   b. *Other sonorant-final clusters:*   Simplification is obligatory (/lm, mn/).
                             These are the clusters that agree in [son].
   c. *Other obstruent-final clusters:*   They behave according to the degree of
                             similarity between the two consonants:
     i. Simplification is obligatory for clusters that agree in [noisy] (/vz, pt, kt/).
     ii. Clusters that do not agree in [noisy] may be reduced only if they end in a stop, subject to the following rules:
        - If the stop agrees in [approximant], [place], and [voice] with the preceding consonant, deletion is obligatory (/st, nd/).
        - If the stop agrees in [approximant] but contrasts in either [place] or [voice] with the preceding consonant, deletion is variable (/sp, sk, ft, mp, nt, ŋk/).
        - If the stop agrees in [vocoid], [place], and [voice] with the preceding consonant, deletion is variable (/ld/).
        - If the stop agrees in [vocoid] but contrasts in [place] and/or [voice] with the preceding consonant, deletion is excluded (/lt, lb, lp, lg, lk/).

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[34]Continuancy dissimilation is also attested in the pronunciation of English word-final obstruent clusters by native speakers of Japanese, Korean, and Cantonese (languages which prohibit tautosyllabic consonant clusters). Eckman (1987) reports that tri-consonantal clusters are typically reduced so as to produce bi-consonantal ones consisting of a stop and a fricative, but not two stops or two fricatives.

**4.3.3.2. Analysis**

The analysis I propose closely follows the generalizations above. It rests on several constraints concerned with contrast or similarity between a consonant and its adjacent segments. These constraints interact with other faithfulness constraints dealing with the weaker resistance of stops to deletion and the merging of approximants with the preceding vowel.

4.3.3.2.1. The constraints and their inherent rankings

The backbone of the analysis is formed by a series of markedness constraints penalizing similarity in manner of articulation.

(96)    RELEVANT MARKEDNESS CONSTRAINTS:
   a.  C (AGR=[+son] ∧ [-vocoid]) ↔ V
       A consonant that agrees in [+son] and [-vocoid] with a neighboring segment is adjacent to a vowel.
   b.  C (AGR=[noisy]) ↔ V
       A consonant that agrees in [noisy] with a neighboring segment is adjacent to a vowel.
   c.  C (AGR=[-approx]) ↔ V
       A consonant that agrees in [-approx] with a neighboring segment is adjacent to a vowel.
   d.  C (AGR=[-vocoid]) ↔ V
       A consonant that agrees in [-vocoid] with a neighboring segment is adjacent to a vowel.
   e.  C ↔ V
       A consonant is adjacent to a vowel.

These constraints are inherently ranked as follows:

(97)    INHERENT RANKINGS AMONG MARKEDNESS CONSTRAINTS:
   a.  C(AGR=[noisy])↔V >> C(AGR=[-app])↔V >> C(AGR=[-voc])↔V >> C↔V
   b.  C(AGR=[+son] ∧ [-vocoid])↔V >> C(AGR=[-vocoid])↔V >> C↔V

These rankings follow from the general ranking schema C(AGR=F∧G)↔V>>C(AGR=F)↔V (3c). The one in (97b) is transparent in this regard. To derive (97a), it suffices to notice that consonants that agree in [-approx] necessarily also agree in [-vocoid] since the set of [-approx] segments is a subset of the set of [-vocoid] ones. The constraint C (AGR=[-app])↔V could be equivalently rewritten as C(AGR=[-app]∧[-voc])↔V, which automatically dominates C(AGR=[-voc])↔V. The same reasoning applies to C(AGR=[noisy])↔V vs. C(AGR=[-app])↔V: segments that agree in noisiness are all obstruents, that is [-sonorant], [-approximant], and [-vocoid]. C(AGR=[noisy])↔V is then equivalent to C(AGR=[noisy]∧[-son]∧[-app]∧[-voc])↔V, which automatically dominates C(AGR=[-app])↔V.

In the context of final clusters in QF, the inherent rankings in (97) serve to encode the generalization that the more contrast in manner of articulation there is between the word-final consonant and the preceding segment, the more likely deletion or coalescence is. When the amount of contrast is minimal, that is when the two consonants are highly similar, deletion targets all types of consonants; when the final consonant contrasts substantially with the preceding one, no deletion takes place. With an intermediate degree of similarity in manner of articulation, only the weaker consonants, i.e. stops, may delete.

To derive these results, the constraints in (96) interact with two series of faithfulness constraints that deal with the two processes that are attested to avoid final clusters: consonant deletion and coalescence with the preceding vowel. The MAX-C constraints, given in (98), are concerned with deletion. These constraints all dominate the general MAX-C constraint.

(98)    MAX-C CONSTRAINTS:
   a.  MAX-C/CONTRAST=[place]
       Do not delete a consonant that contrasts in place of articulation with an adjacent segment.
   b.  MAX-C/CONTRAST=[voice]
       Do not delete a consonant that contrasts in voicing with an adjacent segment.
   c.  MAX-C(-stop)
       Do not delete a consonant that is not a stop.
   d.  MAX-C/V__
       Do not delete a postvocalic consonant.

I assume merging or coalescence between adjacent segments violates uniformity constraints (McCarthy & Prince 1995) (99a). I suggest more specifically a series of constraints of the type in (99b), against output vowels corresponding to another segment in addition to themselves in the input. These constraints may be specified for the type of segments that vowels merge with, as in (100).

(99)   UNIFORMITY CONSTRAINTS:
   a.   UNIFORMITY
        No element in the output has multiple correspondents in the input.
   b.   UNIFORMITY-V
        No vowel in the output corresponds to itself and another segment in
        the input.

(100)  SONORITY-RELATIVE UNIFORMITY-V CONSTRAINTS:
   a.   UNIFORMITY-V [-sonorant]
        No vowel in the output corresponds to itself and a [-sonorant] segment in
        the input.
   b.   UNIFORMITY-V [-approximant]
        No vowel in the output corresponds to itself and a [-approximant]
        segment in the input.
   c.   UNIFORMITY-V [-vocoid]
        No vowel in the output corresponds to itself and a [-vocoid] segment in
        the input.

I propose that the more vowel-like or sonorous a segment is, the more easily
it may coalesce with an adjacent vowel. This effect is obtained with the following
fixed ranking, which encodes the idea that the fusion of an obstruent (-son) with a
vowel is less easily tolerated than that of a nasal (-approximant) or a liquid (-vocoid);
the merging of a glide, including postvocalic /r/ in French, with a vowel only
violates the general constraint UNIF-V, since glides are not relevant to any of the
higher-ranked constraints in (100). See the inherent ranking in (101).

(101)  INHERENT RANKING AMONG UNIFORMITY-V CONSTRAINTS:
        UNIF-V [-son] >> UNIF-V [-app] >> UNIF-V [-vocoid] >> UNIF-V

These are all the constraints that we need in order to derive the QF pattern. I
repeat below the inherent rankings that have been established so far within the
three series of constraints.

(102)  INHERENT RANKINGS ESTABLISHED:
   a.                                        C(AGR=[noisy])↔V
                                             |
        C(AGR=[+son]∧[-vocoid])↔V     C(AGR=[-approx])↔V
                                             |
                                      C(AGR=[-vocoid]) ↔ V
                                             |
                                          C ↔ V
                                             |
                                          C → V

   b.   MAX-C/V__      MAX-C(-stop)     MAX-C/CONT=[voice]     MAX-C/CONT=[pl]

                                 MAX-C

   c.     UNIF-V [-son]
               |
          UNIF-V [-approx]
               |
          UNIF-V [-vocoid]
               |
          UNIF-V
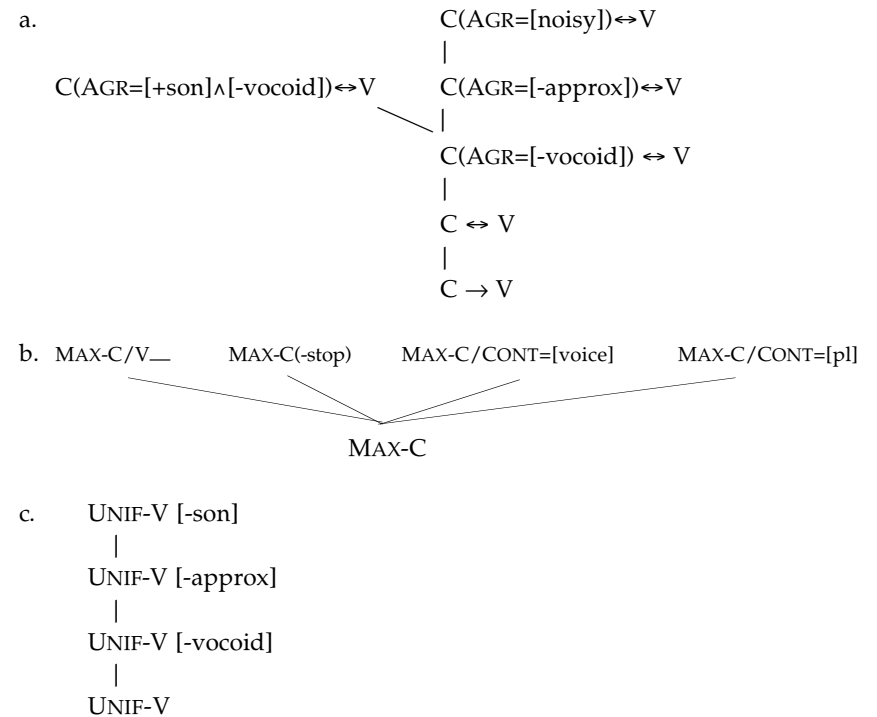
4.3.3.2.2. /r/-initial clusters

Let us now see how these constraints interact and what work they do to yield
the QF deletion pattern. Consider first /r/-initial clusters, composed of a [+vocoid]
segment /r/ followed by a [-vocoid] one. These clusters do not involve agreement
in any of the manner features in (94) and the final consonant only violates the
general constraint C↔V. Consonant deletion, which incurs at least a violation of
MAX-C, is unattested, so we derive the ranking MAX-C >> C↔V (103a). Examples
showing the stability of /r/-initial clusters were given in (65)-(68). The process of
/r/-vocalization, however, is always an option. This process induces a violation of
UNIFORMITY-V. It follows that the ranking between UNIFORMITY-V and C↔V
remains undetermined (103b). The partial rankings given in (103) are illustrated in
the tableau in (104).

(103) RANKINGS SPECIFIC TO QF (/r/-INITIAL CLUSTERS):

  a. MAX-C >> C ↔ V

  b. C ↔ V and UNIFORMITY-V are crucially unranked.

(104) NO DELETION AND /r/ VOCALIZATION IN /-rC/ CLUSTERS:

| (66a) /f$\varepsilon_1$r$_2$m$_3$/ | MAX-C | C ↔ V | UNIFORMITY-V |
|---|---|---|---|
| → f$\varepsilon_1$r$_2$m$_3$ | | (m) | |
| f$\varepsilon_1$r$_2$ | *! | | |
| → f$\varepsilon_{12}$m$_3$ | | | * |
| (68d) /ap$\mathfrak{o}_1$r$_2$t$_3$/ | | | |
| → ap$\mathfrak{o}_1$r$_2$t$_3$ | | (t) | |
| ap$\mathfrak{o}_1$r$_2$ | *! | | |
| → ap$\mathfrak{o}_{12}$t$_3$ | | | * |

### 4.3.3.2.3. Clusters composed of highly similar segments

At the other extreme, consider the clusters that violate the highest-ranked markedness constraints C(AGR=[+son]∧[-vocoid])↔V and C(AGR=[noisy])↔V (96a-b), that is clusters whose members are highly similar in terms of manner of articulation. These clusters include /lm/, /mn/, fricative+fricative, and stop+stop. In the case of /lm/ the /l/ obligatorily merges with the preceding vowel (75), in violation of UNIFORMITY-V [-vocoid]. In the other three cases the final consonant automatically deletes (73, 74, 77).

Stop deletion violates MAX-C, but the omission of nasals and fricatives violates the higher-ranked MAX-C(-stop). Nasals and obstruents do not merge with a preceding vowel: deletion of the following consonant is always preferable. MAX-C(-stop) therefore ranks between UNIFORMITY-V[-approximant] and UNIFORMITY-V[-vocoid]. These facts allow us to derive the additional rankings in (105), applied to one example of each type of cluster in (106). Deletion of the postvocalic consonant is never an option; this would violate MAX-C/V__, which dominates MAX-C(-stop), as determined in (63d). Deletion of the final consonant is therefore necessarily less costly. This is not indicated in (105)-(106).

(105) RANKINGS SPECIFIC TO QF (HIGHLY SIMILAR SEQUENCES):

  a. C(AGR=[+son]∧[-vocoid])↔V ; C(AGR=[noisy])↔V >>
   MAX-C(-stop) >> UNIFORMITY-V (-vocoid)

  b. UNIFORMITY-V (-son) >> UNIFORMITY-V (-approx) >> MAX-C(-stop)

(106) DELETION AND MERGER IN HIGHLY SIMILAR SEQUENCES:

| (75b)/ka$_1$l$_2$m$_3$/ | C(AGR=[+son] ∧[-voc])↔V | C(AGR= [noisy])↔V | UNIF-V [-son] | UNIF-V [-approx] | MAX-C (-stop) | UNIF-V [-vocoid] | MAX-C |
|---|---|---|---|---|---|---|---|
| ka$_1$l$_2$m$_3$ | (m) ! | | | | | | |
| ka$_1$l$_2$ | | | | | * ! | | |
| → ka$_{12}$m$_3$ | | | | | | * | |
| (73a) /i$_1$m$_2$n$_3$/ | | | | | | | |
| i$_1$m$_2$n$_3$ | (n) ! | | | | | | |
| → i$_1$m$_2$ | | | | | * | | |
| i$_{12}$n$_3$ | | | | * ! | | | |
| (74) /ri$_1$v$_2$z$_3$/ | | | | | | | |
| ri$_1$v$_2$z$_3$ | | (z) ! | | | | | |
| → ri$_1$v$_2$ | | | | | * | | |
| ri$_{12}$z$_3$ | | | * ! | | | | |
| (77b) /ka$_1$p$_2$t$_3$/ | | | | | | | |
| ka$_1$p$_2$t$_3$ | | (t) ! | | | | | |
| → ka$_1$p$_2$ | | | | | | | * |
| ka$_{12}$t$_3$ | | | * ! | | | | |

About the loss of /l/ before nasals, it is worth mentioning that this process is not limited to QF. It is attested in other dialects of French, e.g. Louisiana French (Papen & Rottet 1997: 77), and in other languages, e.g. English (see the pronunciation of *calm*, *salmon*, etc.) and Korean (ex. /kulm/ → [kum] 'to starve'; Kenstowicz 1994b). Flemming (1995) notes that laterals and nasals have similar acoustic signals. This observation is consistent with the general claim made here that cluster simplification is motivated by the desire to avoid adjacent segments that do not show a sufficient amount of perceptual contrast.

Before moving on to the next set of clusters, I would like to comment on the proposed account for reduction in nasal+nasal, fricative+fricative, and stop+stop clusters, in regard of the SSP. The absence of any contrast in manner of articulation is what I think motivates deletion of the final segment in these clusters. But one could suggest that they are simplified for sonority reasons. Some languages are said to disallow sonority plateaus, that is sequences of segments with the same level of sonority. There is evidence that this is not the correct explanation, at least for QF. There is some indeterminacy in the sonority hierarchy between stops and fricatives. Either fricatives are more sonorous than stops (e.g. Steriade 1982), or the two types of consonants are equal in sonority (e.g. Clements 1990; Zec 1995), as I have

assumed here. But both options lead to the conclusion that QF does allow sonority plateaus, and that we have to come up with a different explanation for the reduction of N+N, F+F, and S+S clusters.

If fricatives are more sonorous than stops, stop+fricative word-final clusters should be disfavored by the SSP, more so than stop+stop, fricative+fricative, and fricative+stop clusters. The reality is quite different. Stop+fricative sequences are precisely the least marked obstruent clusters and among the most stable word-finally. Morelli (1997, 1999) replicates this result for word-initial obstruent clusters: her typological survey of these clusters shows that stop+fricative clusters are clearly more marked than fricative+stop ones word-initially. This suggests that the SSP is not at play in comparing obstruent clusters, which is why positing sonority distinctions among obstruents is unjustified here.

If fricatives and stops are equal in sonority, all obstruent clusters are expected to be ruled out if sonority plateaus are disallowed. Since such clusters are commonplace in QF, it cannot be the case that these languages do not tolerate sonority plateaus. So some other factor must crucially be involved in the simplification of fricative+fricative and stop+stop clusters, an argument that can be extended to nasal+nasal ones.

The irrelevance of sonority plateaus in cluster simplification in QF is also supported by the fact that the clusters with sonority plateaus that do simplify do so more categorically than obstruent+nasal ones (section 4.3.2.2), which are worse in terms of sonority. According to the SSP, obstruent+nasal clusters should in fact be more marked. It turns out that the same principle of perceptual salience can account for the simplification of all the clusters other than obstruent+sonorant and nasal+liquid ones (which unambiguously violate the SSP). This allows us to dispense entirely with sonority plateaus in QF. This point being made, we are now ready to proceed to the analysis of the remaining obstruent-final clusters.

### 4.3.3.2.4. Clusters composed of moderately similar segments

We have so far accounted for /r/-initial clusters, all the sonorant-final clusters, and those that agree in noisiness. We are left with all the obstruent-final clusters other than F+F and S+S. Let us first look at the clusters that automatically simplify through deletion of the final consonant: /st/ (78) and /nd/ (82). These are clusters whose members agree in [-approximant], place of articulation, and voicing. They contain a moderate amount of contrast in manner of articulation and no contrast in other dimensions. The word-final consonant in these sequences violates the

constraint requiring every consonant that agrees in [-approx] with an adjacent segment to appear next to a vowel: C(AGR=[-approx])↔V (96c). The final consonant is a stop, whose deletion violates the general MAX-C constraint. This leads to the ranking C(AGR=[-approx])↔V >> MAX-C.

Crucially, clusters containing the same amount of contrast but with a final consonant other than a stop are not reduced. This applies to the clusters /ts/ (72c), the mirror image of /st/, and /nz/ (71c). These final fricatives equally violate C(AGR=[-approx])↔V, yet they never delete. Deletion of the fricative would entail a violation of the higher-ranked MAX-C(-stop), which is concerned with consonants other than stops. We can then establish that MAX-C(-stop) outranks C(AGR=[-approx])↔V. We obtain the ranking in (107a).

Some stop-final clusters other than /st/ and /nd/ also violate C(AGR=[-approx])↔V but are only variably reduced. These are /sp, sk, ft/ (79)-(81) and /mp, nt, ŋk/ (83)-(84). /sp, sk, ft/ crucially differ from /st/ in being composed of heterorganic consonants. /mp, nt, ŋk/ and /nd/ are distinguished by the presence vs. absence of a voicing contrast. The members of these clusters are less similar than /st/ and /nd/ because they contain an additional contrast. I suggest that deleting a final stop that contrasts in place of articulation or voicing with an adjacent segment violates MAX-C/CONTRAST=[place] (98a) or MAX-C/CONTRAST=[voice] (98b), respectively. These constraints, which inherently dominate MAX-C, remain unranked with respect to C(AGR=[-approx])↔V, since the final clusters are either retained or reduced by final deletion. The ranking in (107a) is accompanied by the crucial unrankedness in (107b). This is illustrated in (108) with nasal+stop and fricative+stop clusters which do and do not agree in voicing or place of articulation. These clusters contrast with stop+fricative ones (108c).

(107)  RANKINGS SPECIFIC TO QF (MODERATELY SIMILAR SEQUENCES):
     a.  MAX-C(-stop) >> C(AGR=[-approx])↔V >> MAX-C
     b.  MAX-C/CONTRAST=[place], MAX-C/CONTRAST=[voice] and
         C(AGR=[-approx])↔V are crucially unranked.

(108)   DELETION AND RETENTION IN MODERATELY SIMILAR SEQUENCES:

| /rɛst/ (78c) | MAX-C(-stop) | C(AGR= [-approx])↔V | MAX-C/ CONT=[place] | MAX-C/ CONT=[voice] | MAX-C |
|---|---|---|---|---|---|
| rɛst | | (t) ! | | | |
| → rɛs | | | | | * |
| /ɛrzats/ (72c) | | | | | |
| → ɛrzats | | (s) | | | |
| ɛrzat | * ! | | | | |
| /fɪsk/ (80f)   vs. /rɪsk/ (80c) | | | | | |
| → fɪsk vs. rɪsk | | (k) | | | |
| fɪs vs. → rɪsk | | | * | | * |
| /band/ (82b) | | | | | |
| band | | (d) ! | | | |
| → ban | | | | | * |
| /sprint/ (84c)   vs. /drɪŋk/ (83d) | | | | | |
| → sprɪnt vs. drɪŋk | | (t,k) | | | |
| sprin vs. →drɪŋ | | | | * | |

(110)   DELETION AND RETENTION IN /l/+OBSTRUENT CLUSTERS:

| /sɔ$_1$l$_2$d$_3$/ (89a)   vs. /leopɔ$_1$l$_2$d$_3$/ (90a) | MAX-C (-stop) | MAXC/ CONT=[place] | MAX-C/ CONT=[voice] | UNIFOR-V (-vocoid) | C(AGR= [vocoid])↔V | MAX-C |
|---|---|---|---|---|---|---|
| → sɔ$_1$l$_2$d$_3$ vs. leopɔ$_1$l$_2$d$_3$ | | | | | (d) | |
| sɔ$_1$l$_2$ vs. → leopɔ$_1$l$_2$ | | | | | | * |
| sɔ$_{12}$d$_3$ / leopɔ$_{12}$d$_3$ | | | | * ! | | |
| /va$_1$l$_2$s$_3$/ (70a) | | | | | | |
| → va$_1$l$_2$s$_3$ | | | | | (s) | |
| va$_1$l$_2$ | * ! | | | | | |
| va$_{12}$s$_3$ | | | | * ! | | |
| /revɔ$_1$l$_2$t$_3$/ (88a) | | | | | | |
| → revɔ$_1$l$_2$t$_3$ | | | | | (t) | |
| revɔ$_1$l$_2$ | | * ! | | | | * |
| revɔ$_{12}$t$_3$ | | | | * ! | | |
| /divɣ$_1$l$_2$g$_3$/ (88h) | | | | | | |
| → divɣ$_1$l$_2$g$_3$ | | | | | (g) | |
| divɣ$_1$l$_2$ | | * ! | | | | * |
| divɣ$_{12}$g$_3$ | | | | * ! | | |

The final category of clusters we have to consider is the /l/+obstruent one. Here /ld/ optionally loses its final stop (89)-(91), but the other combinations are stable, whether ending in a fricative (70) or a stop (88). In terms of manner of articulation, /l/+obstruent clusters violate C(AGR=[-vocoid])↔V (96d), which is ranked lower than C(AGR=[-approx])↔V. The non-deletion of final fricatives results from the relatively high ranking of MAX-C(-stop), as seen above. Coalescence of /l/ with the preceding vowel is also excluded, which we can account for by positing UNIFORMITY-V (-vocoid) >> C(AGR=[-vocoid])↔V. The only consonant that may delete is /d/, which agrees in both place and voicing with the preceding lateral. Deletion in this case violates only the lowest-ranked MAX-C, which remains crucially unranked with respect to C(AGR=[-vocoid])↔V. All the other /l/+stop clusters involve a contrast in place and/or voicing. Deletion would lead to a violation of MAX-C/CONTRAST=[place] and/or MAX-C/CONTRAST=[voice]. We conclude that the following ranking must hold:

(109)   RANKINGS SPECIFIC TO QF (/l/+OBSTRUENT CLUSTERS):
       MAX-C/CONT=[place] ; MAX-C/CONT=[voice] ; UNIFORMITY-V (-vocoid) >>
       C(AGR=[-vocoid])↔V ; MAX-C

The final constraint ranking for cluster simplification in QF is given in (111). Thin lines indicate inherent rankings; thick ones indicate rankings that were established empirically and are specific to QF.

(111)

C(AGR=[+son, -voc])<->V       C(AGR=[noisy])<->V

SSP(3)    Max-C/V__

Unif-V (-son)
Unif-V (-approx)

SSP(2)

SSP(1)    Max-C(-stop)

Unif-V (-vocoid)

Max-C/CONT=place
Max-C/CONT=voice    C(AGR=[-appr]<->V

Max-C

Unif-V       C(AGR=[-vocoid]<->V

C<->V
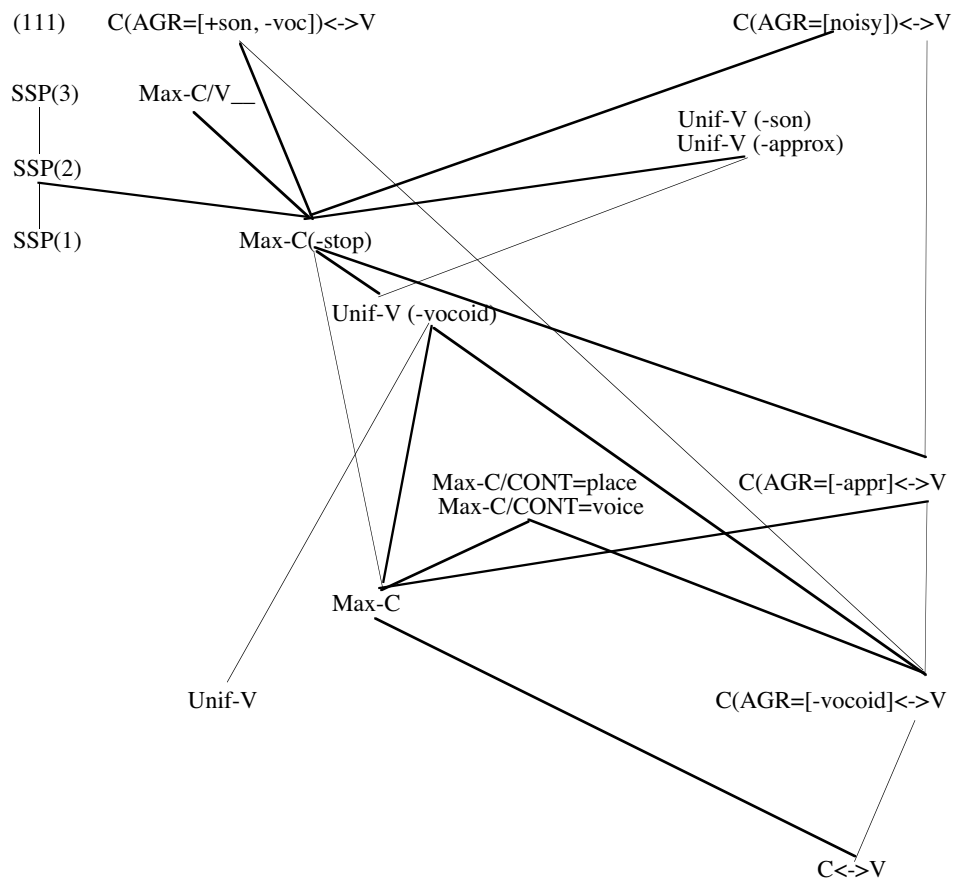
This grammar contains four zones of variability:

1. Indeterminate ranking between UNIFORMITY-V and C↔V yields variable /r/-vocalization.[35]

2. Indeterminate ranking between SSP(1) and MAX-C(-stop) yields variable final deletion in obstruent+nasal clusters.

3. Indeterminate ranking between C(AGR=[-app])↔V, MAX-C/CONTRAST=[Place], and MAX-C/CONTRAST=[voice] yields variable final deletion in [sk, sp, ft] and [mp, nt, ŋk].

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[35]UNIFORMITY-V is also unranked with respect to C→V since vocalization is also possible with simple post-vocalic /r/. This is not indicated in the graph.

4. Indeterminate ranking between C(AGR=[-vocoid])↔V and MAX-C yields variable final deletion in [-ld].

### 4.3.3.3. A similar pattern: Philadephia English

Philadelphia English presents a pattern of word-final consonant deletion that is strikingly similar to the QF one. Word-final stop deletion in English depends on a number of factors, among others the phonological environment and the morphological status of the final stop. Focusing on the nature of the preceding segment on final coronal stop deletion, Guy and Boberg (1997) observe that /t, d/ delete more frequently in natural speech after the segments in (112a) and least frequently (practically never) after those in (112c), the segments in (112b) forming an intermediate category.

(112)   a.   stops (*act*);
      coronal fricatives (*wrist*);
      /n/ (*tend*, *tent*)
  b.   /l/ (*cold*, *colt*);
      non-coronal fricatives (*draft*);
      non-coronal nasals (*summed*)
  c.   /r/ (*cart*)

This hierarchy is extremely similar to the one given in (92) for QF, although the number of possible consonant combinations is much smaller since we are dealing only with word-final coronal stop deletion. As in QF, /r/-initial clusters never simplify (class 3) and clusters that agree in noisiness lose their final stop most frequently (/pt, kt/, class 1). More similarity in manner of articulation favors deletion: stops that agree in [-approximant] with the preceding consonant delete more readily, all else being equal, than stops that only agree in [-vocoid]. Compare in this respect /nd, nt/ (112a) with /ld, lt/ (112b). Contrast in place of articulation between the two segments has in both languages an inhibiting effect on deletion: /st/ reduces more frequently than /ft/ in Philadelphia English, and /nd, nt/ more frequently than /md/. Voicing contrasts seem to have a more categorical effect on the likelihood of deletion in QF than in Philadelphia English, but they do act in the expected direction in the latter language as well. In QF /nd/ and /ld/ fall into different categories from /nt/ and /lt/ in terms of the likelihood of final stop deletion. In PE, /nd/ and /ld/ fall into the same broad groups as /nt/ and /lt/, but Guy & Boberg (1997) confirm that the clusters that agree in [voice] /nd, ld/ reduce more often than those whose members do not share the same value for that feature.

The generalizations that apply to the PE facts in (112) closely replicate those obtained for QF. This convergence is all the more interesting since these generalizations are based on distinct types of data. Guy & Boberg work in a variable rule sociolinguistic approach and use only actual frequencies based on real speech corpora, whereas I give a large part to introspective judgments. I believe this simultaneously supports the validity of speakers' judgments and strengthens the evidence for the role of syntagmatic contrast in consonant deletion.

## 4.4. CONCLUSIONS

This chapter has discussed the role of similarity/contrast between adjacent segments in deletion and epenthesis processes. Identity avoidance has long been established as a meaningful factor in phonology, embedded in particular in the OCP. The perceptual approach developed here improves upon the OCP in several ways, and it can be usefully characterized by means of a comparison with the OCP. First, it integrates similarity avoidance within a more general framework based on the notion of perceptibility, and provides a motivation for it. Similarity correlates with modulation in the acoustic signal, which is a major component of segment perceptibility. Second, our constraint system straightforwardly accounts for the gradient nature of identity avoidance: the more similarity a certain segmental configuration involves, the more marked it is. This contrasts with the categorical formulation of the OCP. Third, we have uncovered the existence of relative identity avoidance phenomena, whereby the degree of similarity that a segment tolerates with an adjacent segment is dependent upon the quality and quantity of perceptual cues otherwise available to that segment. The perceptual-cue approach can naturally handle such phenomena, whereas the OCP only deals with absolute identity avoidance, whereby a specific level of similarity is prohibited between two adjacent segments, irrespective of the context in which they appear.

A range of deletion and epenthesis patterns involving similarity avoidance were analyzed, showing the relevance of manner of articulation, place of articulation, laryngeal setting, and combinations of these dimensions in the computation of contrast. A major portion of the chapter was devoted to the detailed description and analysis of word-final cluster reduction in Québec French, which derives from intricate interactions between different levels of contrast, the distinct behavior of stops vs. other consonants, possible coalescence between vowels and a following approximant segment, and the SSP.

# Chapter 5

# EDGE EFFECTS

## 5.1. INTRODUCTION

In this chapter I investigate in more detail what I call edge effects, which refer to the fact that more complex combinations of consonants are typically allowed at edges of prosodic domains, as opposed to domain-internal positions. This observation is recurrent and has established itself as one of the basic generalizations in phonology. The greater tolerance for consonant clusters at edges explains the presence of an asymmetry in the application of certain phonological processes between internal positions and edges of prosodic constituents. The cases I am concerned with are given in (1). All of them result in more consonants being licensed at domain edges than domain-internally.

(1)     ASYMMETRICAL APPLICATION OF DELETION AND EPENTHESIS:
        a. Consonant deletion applies domain-internally but not at domain edges.
        b. Vowel epenthesis applies domain-internally but not at domain edges.
        c. Vowel deletion applies at domain edges but not domain-internally.

One example of each of the asymmetrical application of the processes in (1) is given below. Consonant deletion in Kamaiurá is illustrated in (2) (McCarthy & Prince 1993; Wiltshire, to appear; based on Everett & Seki 1985). This language has a reduplication process that copies to the right the last two syllables of the base. When the base ends in a consonant, for example /ŋ/ in (2a) or /k/ in (2b), this consonant is lost word-medially and surfaces only word-finally in the reduplicant.

(2)     CONSONANT DELETION IN KAMAIURÁ:
        a.  /o-mo-tumuŋ-tumuŋ/→ [o-mo-tumu-tumuŋ]     'he shook it repeatedly'
        b.  /je-umirik-mirik/      → [je-umiri-mirik]        'I tie up repeatedly'

In (3) I provide two examples of vowel epenthesis in Ponapean (Rehg & Sohl 1981). Here we have a reduplication pattern which copies to the left the first CVC sequence of the base. The final consonant of the reduplicant triggers the insertion of a copy of the preceding vowel, underlined in the data. But the same consonant freely appears word-finally. Compare the reduplicant-final [p] with the word-final [d] in (3a): only the former triggers [i]-insertion.

(3)     VOWEL EPENTHESIS IN PONAPEAN:
        a. /sip-siped/       →      [sipi-siped]              'to shake out-DURATIVE'
        b. /was-wasas/       →      [wasa-wasas]              'to stagger-DURATIVE'

Vowel deletion is illustrated in (4). In Lardil (K. Hale 1973), stem-final vowels delete word-finally, but they are kept before a morpheme inside the word, for example the future morpheme /-wuṛ/ below. See also Piggott (1980, 1999) for a similar pattern in Ojibwa.

(4)     APOCOPE IN LARDIL:
        a. /karikari/        →      [karikar]                'butter-fish'
                             vs.    [karikari-wuṛ]           'butter-fish-FUTURE'
        b. /yiliyili/        →      [yiliyil]                'oyster sp.'
                             vs.    [yiliyili-wuṛ]           'oyster sp.-FUTURE'

The standard solution to these edge effects provided by the prosodic approach to phonotactics involves extrasyllabicity. This concept was already discussed in the more general context of the role of syllable well-formedness in deletion and epenthesis processes, in chapter 1, section 1.2.1.1. I simply repeat the relevant points here. According to the requirement of exhaustive syllabification, consonants have to be incorporated into well-formed syllables. But it has been proposed that consonants at margins of prosodic domains may remain extrasyllabic and escape syllable well-formedness conditions. This idea has been implemented in various ways, which differ on how edge consonants are represented and how they are ultimately licensed. The following four approaches were mentioned:

(5)     APPROACHES TO EXTRASYLLABICITY:
        a. *Extrametricality:* Edge consonants are marked as extrametrical for syllabification purposes, and are ultimately licensed by adjoining to a syllable late in the derivation, once syllable well-formedness conditions no longer apply (Borowsky 1986; Itô 1986; Booij 1999).
        b. *Final consonants as onsets:* Final consonants are represented as onsets of empty-headed syllables and are not subject to the coda conditions that apply to domain-internal codas. This approach is prominent in Government Phonology (e.g. Kaye 1990); see also Dell (1995) for French.
        c. *Indirect licensing*: Edge segments are licensed not by the syllable but by a higher constituent, especially the prosodic word (Piggott 1999; Spaelti 1999; Auger & Steele 1999; Steele & Auger 1999).

d. *Alignment* (Wiltshire 1994, 1998, to appear; Clements 1997): Extrasyllabicity is derived by interactions between constraints on syllable structure and alignment constraints with higher prosodic domains.

The Kamaiurá case in (2), for instance, would be accounted for by simply positing a CV syllable template with word-final extrasyllabicity. The word-internal base-final consonant /ŋ/ or /k/ cannot be incorporated in a CV syllable; therefore it deletes. But the same consonant is licensed word-finally, where the effects of syllable well-formedness conditions are suspended.

I have argued that syllable well-formedness is irrelevant in conditioning the application of deletion and epenthesis processes. Extrasyllabicity is therefore not a viable concept. I have proposed a different approach to edge effects, based on the Principle of Perceptual Salience and the existence of cue enhancement processes at edges of prosodic domains. The perceptibility of consonants in peripheral positions is enhanced by a number of phonetic processes: lengthening, articulatory strengthening, and reduction of the amount of overlap with adjacent segments (see section 3.1.5). This increased perceptibility is what makes consonants more easily tolerated at edges of prosodic constituents. This idea is encoded in the constraints in (6), repeated from (14) in chapter 3, which are inherently ranked as in (7). This inherent ranking expresses that, all else being equal, the higher the prosodic boundary a consonant is adjacent to, the more easily it surfaces without the support of a following or adjacent vowel. It follows that consonants that are not adjacent to any prosodic boundary, i.e. word-internal consonants, are the weakest.

(6)    CONSTRAINTS ENCODING THE ROLE OF PROSODIC BOUNDARIES:

     a.   $C|_i \leftrightarrow V$      A consonant that is next to a boundary i is adjacent to a vowel.

     b.   $C|i \rightarrow V$      A consonant that is next to a boundary i is followed by a vowel.

(7)    INHERENT RANKINGS BETWEEN MARKEDNESS CONSTRAINTS:

     a.   $C|_i \leftrightarrow V \gg C|_j \leftrightarrow V$      if i is a boundary weaker than j (including Ø)

     b.   $C|_i \rightarrow V \gg C|_j \rightarrow V$      if i is a boundary weaker than j (including Ø)

Since the right and left edges of domains do not necessarily behave in a parallel fashion (which is consistent with the fact that the phonetic processes associated with initial and final positions are partly distinct), the constraints in (6) and their corresponding inherent rankings have to be specified for the left or right edge, as in (8) and (9).

(8)    CONSTRAINTS ENCODING THE ROLE OF FOLLOWING BOUNDARIES:

     a.   $C]_i \leftrightarrow V$      A consonant that is followed by a boundary i is adjacent to a vowel.

     b.   $C]i \rightarrow V$      A consonant that is followed by a boundary i is followed by a vowel.

(9)    CONSTRAINTS ENCODING THE ROLE OF PRECEDING BOUNDARIES:

     a.   $_i[C \leftrightarrow V$      A consonant that is preceded by a boundary i is adjacent to a vowel.

     b.   $_i[C \rightarrow V$      A consonant that is preceded by a boundary i is followed by a vowel.

This chapter contributes both empirically and theoretically to the study of edge effects. First, edge effects have been investigated almost exclusively at the word level, and the existence of similar effects at levels higher than the word has not been properly described and analyzed. Moreover, edge effects appear to be cumulative as we go up the prosodic hierarchy; that is, consonants are more and more easily tolerated as the strength of the prosodic boundary increases. This cumulativity effect has gone essentially unnoticed. The main goal of this chapter is therefore to present patterns of consonant deletion, vowel epenthesis, and vowel deletion that display edge effects at levels above the word and cumulative edge effects. Cumulativity has already been illustrated in the application of degemination in Hungarian (section 1.2.3.1) and schwa epenthesis in French (section 2.3.6); additional patterns will be provided. We will also see how the perceptual approach advocated here naturally and simply accounts for edge effects and their cumulative behavior, without the need for exceptional mechanisms such as extrasyllabicity. I will develop in greater detail one case study: consonant deletion and vowel epenthesis in Basque, with special emphasis on the dialect of Ondarroa.

## 5.2. EXPANDING THE EMPIRICAL BASIS OF EDGE EFFECTS

Deletion and epenthesis patterns that display edge effects can be characterized in terms of four parameters, listed in (10).

(10)    PARAMETERS FOR PATTERNS DISPLAYING EDGE EFFECTS:

     a.   *Configuration tolerated at edges but avoided domain-internally:* Consonant not followed by a vowel / Consonant not adjacent to a vowel

     b.   *Edge:*     Left / Right

     c.   *Levels:*     PW, PP, IP, U

     d.   *Process:*   Consonant deletion / vowel epenthesis / vowel deletion

The first parameter (10a) describes the segmental configuration that is avoided domain-internally but tolerated at domain edges. Two cases arise in the context of the phonological processes investigated here: 1. consonants need to be adjacent to a vowel domain-internally but not at edges; 2. consonants need to be followed by a vowel domain-internally but not at edges. The Kamaiurá, Ponapean, and Lardil cases in (2)-(4) exemplify the first option: in all three cases, the deletion or epenthesis process applies in such a way that the same consonant is followed by a vowel word-internally but not word-finally, e.g. [s] in [wasa-wasas] (3b). Other patterns described in this chapter will illustrate the other possibility: consonants are adjacent to a vowel word-internally but not at edges. These two configurations are directly related to the two types of markedness constraints I have been using: C→V and C↔V. Also, edge effects often preferentially or exclusively affect stops, which, more than other consonants, want to be adjacent to or followed by a vowel. All consonants may be tolerated at edges but only non-stops in internal positions, so that edge effects only benefit stops.

The last parameter (10d) simply states what process edge effects arise from. The second parameter (10b) tells whether the freer distribution of consonants is permitted at the left edge only (domain-initially), at the right edge only (domain-finally), or at both edges. The third parameter (10c) specifies the prosodic level or levels that display(s) edge effects, that is the domain or constituent in which a certain configuration is less easily tolerated in internal positions than at edges. Our three examples above are all cases of final or left edge effects, at the level of the Prosodic Word. Other combinations will obviously be exemplified in the remainder of this chapter. Crucially, edge effects may be cumulative and appear at more than one level. I adopt the simple prosodic hierarchy in (11), given for example in Inkelas & Zec (1995), and assume that constituents below the PW level belong to a separate hierarchy (Selkirk 1986; Zec 1988; Inkelas 1989).[1]

(11)    THE PROSODIC HIERARCHY:

         Utterance (U)                          ↑
            |                                    |
         Intonational phrase (IP)                |        Edge effects
            |                                    |        increase
         Phonological phrase (PP)                |
            |                                    |
         Prosodic word (PW)                      |

In the table below I provide several examples of processes displaying edge effects above the PW level. For each of them I specify the four parameters in (10), including whether stops are preferentially or exclusively targeted, together with the references in which the pattern is described. For some patterns the phrasal level at which edge effects appear is not made clear in the sources; in these cases I have only indicated "(phrase)", which could correspond to either a PP, an IP, or the Utterance.

Before describing and analyzing these patterns, we may look at the table in more detail and see whether any tendencies or generalizations emerge regarding the four parameters listed. The small number of cases does not permit me to make secure statements, but I will venture three hypotheses, which further research should confirm or disconfirm.

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[1]It follows from this assumption that my approach makes no prediction with respect to the existence of edge effects below the PW, in particular at the foot level. Green (1997), looking at syllabification in Munster Irish, finds that all sequences of rising sonority are tolerated word-initially, only a subset of them foot-initially, and none foot-internally. Epenthesis applies to break up the disallowed sequences. Such results suggest that we may have to add the foot level to our hierarchy of edge effects. However, it seems that the pattern described can be reanalyzed without reference to the foot but only to the position of stress. Rising sonority clusters are better tolerated before stressed vowels than unstressed ones.

(12)    SOME LANGUAGES DISPLAYING EDGE EFFECTS ABOVE THE PW IN THE
         APPLICATION OF DELETION OR EPENTHESIS PROCESSES:

| LANGUAGE | L/R EDGE | AVOIDED CONFIGURATION | LEVEL(S) | PROCESS(ES) | REFERENCES |
|---|---|---|---|---|---|
| Cairene Arabic | R | C not adjacent to V | (Phrase) | V epenthesis | Broselow 1980, 1992; Selkirk 1981; Wiltshire 1994, 1998, to appear |
| Iraqi Arabic | L | C not adjacent to V | (Phrase) | V epenthesis | Broselow 1980, 1992; Selkirk 1981 |
| Arrernte | L, R | C not adjacent to V | (Phrase) | V deletion V epenthesis | Breen & Pensalfini 1999 |
| Ondarroa Basque | R | Stops/affricates (marginally other C's) not followed by V | PW, IP | C deletion V epenthesis Affricate simplif. | Côté 1999 |
| Vimeu Picard | R, L | C not adjacent to V | PW, IP | V epenthesis | Steele & Auger 1999; Auger & Steele 1999; Auger (2000, p.c.) |
| French | R, L | C not adjacent to V, stops in particular | PW, PP, IP | V epenthesis V deletion | Dell 1977 |
| Marais Vendéen | R | Stops not followed by V | PP | C Deletion | Svenson 1959; Morin 1986 |
| Kayardild | R | C not adjacent to V, stops in particular | IP | V deletion | Evans 1995a,b |
| Tiwi | R | C not adjacent to V | IP / U | V deletion | Lee 1987 |

First, in all but two of these cases, which deal with edge effects above the PW, the avoided configuration is consonants that are not *adjacent* to a vowel. This contrasts with the three patterns in (2)-(4), in which consonants need to be *followed* by a vowel PW-internally but not PW-finally. This correspondence between the avoided configuration and the level at which edge effects appear may be a statistical accident, but I can also see one plausible explanation for it. The requirement that consonants be followed by a vowel is more demanding than the one stating that consonants should only be adjacent to a vowel. It is possible that this stricter requirement is relaxed more easily than the looser one, that is at lower prosodic levels. Consonants may be required to be followed by a vowel only in the smallest domain, that is PW-internally, where they benefit from no cue enhancement, with edge effects showing up already at PW edges. But relaxing the requirement that consonants be adjacent to a vowel demands better perceptual conditions, which may be obtained only at edges of stronger boundaries, which are associated with significantly better cues.

Second, one may discern a slight tendency for edge effects to be more frequent at the right edge. I suspect that such a tendency, if it is confirmed, is related to the importance of word-initial material for lexical access and processing, which tends to make the left edge more stable across prosodic contexts, and consequently less subject to the type of alternations investigated here (see also Beckman's (1998) root-initial faithfulness). Crucially, we are concerned with asymmetries in the application of phonological processes, not with segmental patterns found in the lexicon. It could be that edge effects at the left edge are more often lexicalized, while those at the right edge are more easily subject to phonological alternations.[2]

Finally, edge effects appear to be more frequent at the PW and IP levels, as opposed to the PP and U ones. One may wonder whether there is anything in the phonetics that makes these domains special. About the PW, I would like to suggest that the inter-segmental timing of gestures, which determines the amount of overlap between adjacent segments, is more variable at word boundaries than word-internally. So timing and the amount of overlap at PW junctures may be actively manipulated by speakers, if necessary, in order to accomodate more complex sequences of segments. Manipulation may be more constrained word-internally, which limits the range of possible phonotactic combinations. Phonetic experiments are necessary to enlighten this issue.[3] As for the IP level, it is the one at which pauses may be introduced (Nespor & Vogel 1986, Keating et al. 1998, Wightman et al. 1992), which lead to a complete elimination of overlap with adjacent segments.

**5.3. FIRST CASE STUDIES**

Six of the patterns listed in the table in (12) will now be described and analyzed. They illustrate the various aspects of the approach developed here and all

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[2]As noted in chapter 2, underlying schwas in morpheme-initial syllables in French tend to stabilize or disappear altogether. This could be interpreted as a consequence of the tendency to avoid domain-initial phonological alternations.

[3]Byrd (1994) compared the amount of overlap between two adjacent segments in different prosodic contexts: separated by a word boundary $C_1 \# C_2$, word-initially $\# C_1 C_2$, and word-finally $C_1 C_2 \#$. The results she obtained are not consistent. For the sequence [sk], she found that overlap between the two consonants was most variable when they were separated by a word boundary, less variable in coda clusters, and least variable in word-initial clusters. But for the sequences [g#d] vs. [gd#] and [g#s] vs. [ks#], she found no significant difference between the word-final clusters and those separated by a word juncture (the corresponding onset clusters were not examined for these combinations). These results only partly bear on the hypothesis made here about the special status of PW boundaries, since all the clusters investigated by Byrd are adjacent to a word boundary. Comparisons have to be made with similar clusters in word-internal position. Moreover, Byrd's experiments were conducted on clusters embedded in meaningless carrier sentences like "Type bag sab again" [g#s]. Different results might obtain with natural speech.

present a specific interest. Cairene and Iraqi Arabic are first used to introduce the analysis of right and left edge effects (5.3.1). Schwa epenthesis in French shows the interaction of initial and final cumulative edge effects with the contrast between stops and other consonants in the probability of epenthesis (5.3.2). The process of stop deletion in Marais-Vendéen is noteworthy as it seems to involve a categorical distinction based on the Maximal Phonological Phrase, which is an unusual level in categorical edge effects (5.3.3). Epenthesis in Vimeu Picard brings in the support of statistical data obtained from real speech (5.3.4). The complex case of edge effects in Basque is described and analyzed in detail in section 5.4. The interest of this pattern lies mainly in the application of several different processes to avoid a marked situation. In addition, the processes are dependent upon the existence of lexical distinctions between closed and open lexical categories, and interactions of phonotactics with the opacity present in the inflectional system, through the use of flectional markers as phonotactically-motivated epenthetic elements.

### 5.3.1. EPENTHESIS IN CAIRENE AND IRAQI ARABIC

Let us first consider the simple and often mentioned epenthesis patterns in Cairene and Iraqi Arabic, which are convenient for a first illustration of our approach. The patterns in the two dialects are essentially the mirror image of each other (Broselow 1980, 1992; Selkirk 1981; Wiltshire 1994, 1998, to appear). In both dialects consonants appear adjacent to a vowel phrase-internally. To enforce this rule an epenthetic [i] is inserted when necessary, that is inside clusters of three (or more) consonants.[4] This vowel appears between the first two consonants in Iraqi (13) and the last two in Cairene (14), a distinction that does not concern us here.

(13)    OBLIGATORY EPENTHESIS PHRASE-INTERNALLY IN IRAQI ARABIC:
   a.   /gil-t-l-a/          →     [gilitla]            'I said to him'
   b.   /katab-t ma-ktuub/   →     [katabitmaktuub]  'I wrote a letter'
   c.   /triid ktaab/        →     [triidiktaab]       'you want a book'

(14)    OBLIGATORY EPENTHESIS PHRASE-INTERNALLY IN CAIRENE ARABIC:
   a.   /katab-t-l-u/        →     [katabtilu]         'I/you wrote to him'
   b.   /katabt gawaab/      →     [katabtigawaab]     'you (m.) wrote a letter'
   c.   /bint nabiiha/       →     [bintinabiiha]      'an intelligent girl'

---

[4]Broselow (1980), however, notes that epenthesis may fail to apply in Iraqi between a word-final sonorant+obstruent clusters followed by a consonant, e.g. [banj ɣaali] 'an expensive local anesthetic'. I will disregard this case.

At phrase boundaries, consonants not adjacent to a vowel are tolerated and do not automatically trigger epenthesis. The two dialects, however, differ on whether the requirement that consonants be adjacent to a vowel is relaxed initially or finally. In the Iraqi dialect, epenthesis is only optional in phrase-initial clusters (15), so that a phrase-initial consonant variably surfaces without an adjacent vowel. But vowel insertion still applies phrase-finally (16). In Cairene, epenthesis fails to apply phrase-finally, where we find consonants that are not adjacent to a vowel (17), but still takes place phrase-initially (18).

(15)    OPTIONAL EPENTHESIS PHRASE-INITIALLY IN IRAQI ARABIC:
   a.   /qmaaʃ/              →     [(i)qmaaʃ]           'cloth'
   b.   /klaab/              →     [(i)klaab]           'dogs'

(16)    OBLIGATORY EPENTHESIS PHRASE-FINALLY IN IRAQI ARABIC:
   a.   /kitab+t/            →     [kitabit]            'I wrote'
   b.   /gil+t/              →     [gilit]              'I said'

(17)    NO EPENTHESIS PHRASE-FINALLY IN CAIRENE ARABIC:
   a.   /katab+t/            →     [katabt]             'you wrote'
   b.   /bint/               →     [bint]               'girl'

(18)    OBLIGATORY EPENTHESIS PHRASE-INITIALLY IN CAIRENE ARABIC:
        /ktib/               →     [(ʔ)iktib]           'write!'

Whereas Broselow (1980, 1992) and Wiltshire (1994, 1998, to appear; for Cairene only) are not explicit on the nature of the precise phrasal level that manifests edge effects, Selkirk (1981) states that the positions that tolerate consonants not adjacent to a vowel correspond to the postpausal (Iraqi) or prepausal (Cairene) ones, which she equates with utterance-initial and utterance-final. I assume that her use of "utterance" corresponds to the U level in the prosodic hierarchy in (11).

The constraint ranking that yields the Arabic patterns is easy to establish. The hierarchy in (11) associated with the rule for establishing inherent rankings in (7) yields the fixed rankings of markedness constraints in (19), which also incorporate the inherent dominance between any constraint of the type C↔V and the corresponding C→V constraint. When necessary, the rankings apply specifically to the right (20a) and left (20b) edges of prosodic domains. The symbol Ø obviously refers to the absence of a prosodic boundary, found in PW-internal positions. Our task in all the patterns investigated in this chapter will then be to appropriately rank faithfulness constraints within this web of markedness constraints.

(19)  INHERENT RANKING OF BOUNDARY-SPECIFIC CONSTRAINTS:

```
              C|∅ ↔V
           /        \
    C|PW ↔V          C|∅ →V
       |                |
    C|PP ↔V          C|PW →V
       |                |
    C|IP ↔V          C|PP →V
       |                |
    C|U ↔V           C|IP →V
           \        /
              C|U →V
```
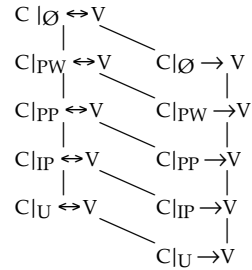
(20)  INHERENT RANKINGS FOR FOLLOWING AND PRECEDING BOUNDARIES:

a.
```
              C]∅ ↔V
           /        \
    C]PW ↔V          C]∅ →V
       |                |
    C]PP ↔V          C]PW →V
       |                |
    C]IP ↔V          C]PP →V
       |                |
    C]U ↔V           C]IP →V
           \        /
              C]U →V
```

b.
```
              ∅[C ↔V
           /        \
    PW[C ↔V          ∅[C →V
       |                |
    PP[C ↔V          PW[C →V
       |                |
    IP[C ↔V          PP[C →V
       |                |
    U[C ↔V           IP[C →V
           \        /
              U[C →V
```
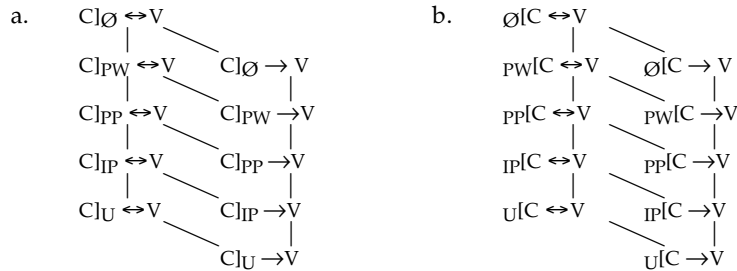
In both Iraqi and Cairene Arabic, the relevant markedness constraints are those of the C↔V type, which ban consonants that are not adjacent to a vowel. Violations of these constraints are avoided by epenthesis, which violates DEP-V. This constraint has to rank lower than other faithfulness constraints dealing with alternative processes, in particular MAX-C.[5] Insertion is obligatory U-internally in both dialects, so we have C|IP ↔V >> DEP-V. In Iraqi it is also obligatory U-finally (18), from which we derive C]U ↔V >> DEP-V, but optional U-initially, which is accounted for with an indeterminate ranking between DEP-V and U[C↔V. In Cairene epenthesis is obligatory U-initially but excluded U-finally, hence the ranking U[C ↔V >> DEP-V >> C]U ↔V. The final rankings for both dialects are provided in (21) and illustrated in the following tableaux. I disregard the locus of epenthesis and the issue of how it is determined in each dialect (see chapter 3, sections 3.2.3 and 3.3.1).

(21)  RANKINGS SPECIFIC TO CAIRENE AND IRAQI ARABIC:

    a.  Iraqi:     C|∅ ↔V >> ... >> C|IP ↔V ; C]U ↔V >> DEP-V ; U[C ↔V

    b.  Cairene: C|∅ ↔V >> ... >> C|IP ↔V ; U[C ↔V >> DEP-V >> C]U ↔V

---

[5]The fact that the repair strategy chosen in each language is associated with the lowest-ranked faithfulness constraint will be implicit in all the analyses to come.

(22)  VOWEL EPENTHESIS IN IRAQI ARABIC:

| /triid ktaab/ | C\|∅ ↔V >>...>> C\|IP↔V | C]U ↔V | DEP-V | U[C ↔V |
|---|---|---|---|---|
| triidktaab | (k) ! | | | |
| → triidiktaab | | | * | |
| /qmaaʃ/ | | | | |
| → U[qmaaʃ | | | | * |
| → U[iqmaaʃ | | | * | |
| /kitab+t/ | | | | |
| kitabt ]U | | (t) ! | | |
| → kitabit ]U | | | * | |

(23)  VOWEL EPENTHESIS IN CAIRENE ARABIC:

| /bint nabiiha/ | C\|∅ ↔V >>...>> C\|IP↔V | U[C ↔V | DEP-V | C]U ↔V |
|---|---|---|---|---|
| bintnabiiha | (t) ! | | | |
| → bintinabiiha | | | * | |
| /ktib/ | | | | |
| U[ktib | | (k) ! | | |
| → U[(ʔ)iktib | | | * | |
| /katab+t/ | | | | |
| → katabt ]U | | | | (t) |
| katabti ]U | | | * ! | |

**5.3.2. EPENTHESIS IN FRENCH**

The role of the prosodic hierarchy in schwa epenthesis in French was discussed in section 2.3.6. I now provide a formal analysis of it. It was established that in the same segmental context $C_1C_2C_3$, the likelihood that $C_2$ triggers schwa insertion is inversely correlated with the strength of the prosodic boundary that it is adjacent to. This holds at both left and right edges. The following data, repeated from chapter 2, illustrate cumulative edge effects domain-finally in French. In (24) we have the sequence [ktm] with [t] followed by an increasingly stronger boundary, from ∅ to IP. Three levels of acceptability for schwa can be observed: schwa is obligatory PW-internally, excluded at the right edge of IP, and optional at PW, SPP, and MPP boundaries.[6] These levels are indicated by the darkness of the background, according to the following:

---

[6]Recall that I follow Selkirk (1986) and de Jong (1990, 1994), who have proposed that the PP is split between a Small and a Maximal Phonological Phrase (SPP, MPP).

| | Schwa obligatory |
|---|---|
| | Schwa optional |
| | No schwa |

(24)    EFFECT OF THE FOLLOWING BOUNDARY WITH CLUSTER-MEDIAL STOPS:

   *[kt ]$_i$ m], with i ∈{ Ø, PW, ...IP}*

| | | | |
|---|---|---|---|
| a. C$_2$ ]$_Ø$ | *tu fais que te moucher* | 'you only blow your nose' | |
| | /ty=fɛ k=t=muʃe/ | *[tyfɛktmuʃe]  [tyfɛk(ə)t(ə)muʃe] | |
| b. C$_2$ ]$_{PW}$ | *infecte manteau* | 'stinking coat' | |
| | /ɛ̃fɛkt mãto/ | [ɛ̃fɛkt(ə)mãto] | |
| c. C$_2$ ]$_{SPP}$ | *insecte marron* | 'brown insect' | |
| | /ɛ̃sɛkt marɔ̃/ | [ɛ̃sɛkt(ə)marɔ̃] | |
| d. C$_2$ ]$_{MPP}$ | *l'insecte mangeait* | 'the insect was eating' | |
| | /l=ɛsɛ̃kt mãʒɛ/ | [lɛ̃sɛkt(ə)mãʒɛ] | |
| e. C$_2$ ]$_{IP}$ | *l'insecte, mets-le là* | 'the insect, put it there' | |
| | /l=ɛ̃sɛkt mɛlœla/ | *[lɛ̃sɛktəmɛlœla]  [lɛ̃sɛktmɛlœla] | |

*cluster more easily tolerated* (left margin, with downward arrow)

In addition, Dell (1977) showed the existence of clear frequency effects within the optional zone. He compared the probability of schwa omission in the context C$_1$C$_2$#C$_3$ in adjective+noun, noun+adjective, and subject+verb sequences, which correspond to C$_1$C$_2$]$_{PW}$, C$_1$C$_2$]$_{SPP}$, and C$_1$C$_2$]$_{MPP}$, respectively. His numbers for three segmental clusters in which C$_1$ is an obstruent and C$_2$ a stop are given below:

(25)

| C$_1$C$_2$C$_3$ | C$_2$]$_{PW}$ | C$_2$]$_{SPP}$ | C$_2$]$_{MPP}$ |
|---|---|---|---|
| [skv] | 81 | 60 | 15 |
| [ktv] | 78 | 60 | 12 |
| [stv] | 78 | 18 | 6 |

The prosodic structure interacts with the nature of the consonants. It was demonstrated in chapter 2 that schwa insertion is more easily triggered by stops than by other consonants, everything else being equal. The data in (24) can be replicated with the fricative [s] (the reflexive clitic) rather than the stop [t] (the 2nd sg object clitic) in the position of C$_2$.[7] We obtain the data in (26), which crucially differ from those in (24) in that schwa is no longer obligatory before a null boundary Ø. In the same prosodic context, schwa is less likely if C$_2$ is a fricative than if C$_2$ is a stop.

---

[7]The context adjective+noun (C$_2$]$_{PW}$) is not given because I did not find an adjective ending in the cluster [-ks] that could naturally appear in prenominal position.

(26)    EFFECT OF THE FOLLOWING BOUNDARY WITH CLUSTER-MEDIAL FRICATIVES:

   *k s ]$_i$ m, with i ∈{ Ø, PW, ...IP}*

| | | | |
|---|---|---|---|
| a. C$_2$ ]$_Ø$ | *il fait que se moucher* | 'he only blows his nose' | |
| | /il=fɛ k=s=muʃe/ | [ilfɛk(ə)s(ə)muʃe] | |
| b. C$_2$ ]$_{SPP}$ | *annexe marron* | 'brown annexe' | |
| | /anɛks marɔ̃/ | [anɛks(ə)marɔ̃] | |
| c. C$_2$ ]$_{MPP}$ | *l'annexe manquait* | 'the annexe was missing' | |
| | /l=anɛks mãkɛ/ | [lanɛks(ə)mãkɛ] | |
| d. C$_2$ ]$_{IP}$ | *l'annexe, mets-la là* | 'the annexe, put it there' | |
| | /l=anɛks mɛ la la/ | *[lanɛksəmɛlala]  [lanɛksmɛlala] | |

*cluster more easily tolerated* (left margin, with downward arrow)

These data involve the markedness constraints C]$_i$↔V and stop]$_i$↔V, with i being any prosodic boundary and stop]$_i$↔V inherently outranking the corresponding C]$_i$↔V. We obtain the web of inherently ranked constraints in (27), in which we have to integrate the constraint against epenthesis DEP-V.[8]

(27)    INHERENT RANKINGS OF MARKEDNESS CONSTRAINTS:
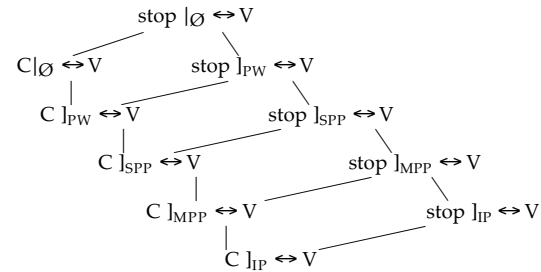


Schwa is obligatory only in the context stop]$_Ø$ (24a) which follows from the ranking stop]$_Ø$↔V >> DEP-V. It is excluded IP-finally, even with stops (24e), so DEP-V >> stop]$_{IP}$↔V. The ranking of DEP-V with all the markedness constraints ranked between stop]$_Ø$↔V and stop]$_{IP}$↔V remains undetermined, which yields optional schwa insertion. The inherent rankings among these constraints, however, generate the desired frequency effects. Epenthesis is more probable with weaker prosodic boundaries and with stops in cluster-medial position. The final ranking we obtain for the right edge is given in (28). The tableaux in (29) and (30) illustrate the

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[8]I disregard segmental factors other than the contrast between stops and fricatives. For instance, schwa insertion is less likely with a stop in cluster-medial position if C$_1$ is /r/ rather than /k/; see section 2.3.5.1. These distinctions ultimately have to be integrated into the constraints, but I omit doing this in order to focus on the prosodic factor.

contrast between stops (obligatory schwa) and fricatives (optional schwa) PW-internally, and the exclusion of schwa IP-finally, respectively.

(28)    PARTIAL GRAMMAR OF FRENCH (FOLLOWING BOUNDARIES):

$$\text{stop }|_\emptyset \leftrightarrow V$$

C$|_\emptyset \leftrightarrow$V          stop $]_{PW} \leftrightarrow$V          **DEP-V**

C $]_{PW} \leftrightarrow$V          stop $]_{SPP} \leftrightarrow$V

C $]_{SPP} \leftrightarrow$V          stop $]_{MPP} \leftrightarrow$V

C $]_{MPP} \leftrightarrow$V          stop $]_{IP} \leftrightarrow$V

C $]_{IP} \leftrightarrow$V
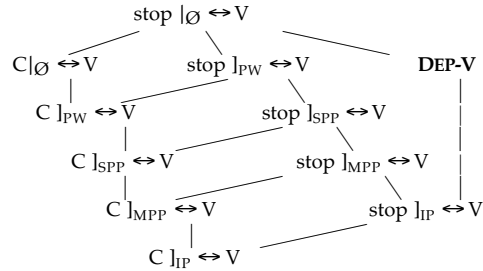
(29)    SCHWA WITH MEDIAL STOPS AND FRICATIVES PW-INTERNALLY:

| /ty=di k=t=mãtir/ | stop]$_\emptyset \leftrightarrow$V | DEP-V | C]$_\emptyset \leftrightarrow$V |
|---|---|---|---|
| tydikt]$_\emptyset$ mãtir | (t) ! | | |
| → tydiktə]$_\emptyset$ mãtir | | * | |
| → tydikət]$_\emptyset$ mãtir | | * | |
| /ty=di k=s=mãtir/ | | | |
| → tydiks]$_\emptyset$ mãtir | | | * |
| → tydiksə]$_\emptyset$ mãtir | | * | |
| → tydikəs]$_\emptyset$ mãtir | | * | |

(30)    NO SCHWA IP-FINALLY:

| /l=ɛ̃sɛkt mɛ lœ la/ | DEP-V | stop]$_{IP} \leftrightarrow$V | C]$_{IP} \leftrightarrow$V |
|---|---|---|---|
| → lɛ̃sɛkt]$_{IP}$ mɛlœla | | (t) | |
| lɛ̃sɛktə]$_{IP}$ mɛlœla | * ! | | |
| /l=anɛks mɛ la la/ | | | |
| → lasɛks]$_{IP}$ mɛlala | | | (s) |
| lanɛksə]$_{IP}$ mɛlala | * ! | | |

Exactly the same situation is found at the left edge of prosodic domains. In (31) and (32) we have the sequences [ktf] and [ksf] with [t] and [s] preceded by a boundary of increasing strength, from Ø to IP. Here we observe that epenthesis is, again, only obligatory with stops PW-internally (31a). But it is optional at IP boundaries, unlike in the examples given in (24) and (26). The difference follows from the different morphological contexts in which the effect of the left and right edges can be tested. In the data below the middle consonant is a clitic, and epenthesis

at clitic boundaries is *always* optional in interconsonantal position (see chapter 2). The ranking we obtain (33) is identical to that given in (28), except for DEP-V, which does not dominate $_{IP}$[stop $\leftrightarrow$V.

(31)    EFFECT OF THE PRECEDING BOUNDARY WITH CLUSTER-MEDIAL STOPS:

$[k_{\,i}[\,t\,f],\ with\ i \in \{\ \emptyset, PW, ...IP\}$

| | | | |
|---|---|---|---|
| \| | ø[ C$_2$ | *tu fais que te faire mal* | 'you only hurt yourself' |
| cluster | | /ty=fɛ k=t=fɛr mal/ | *[tyfɛktfɛrmal]   [tyfɛk(ə)t(ə)fɛrmal] |
| more | MPP[ C$_2$ | *Jean-Luc te fait mal* | 'J. hurts you' |
| easily | | /ʒãlyk t=fɛ mal/ | [ʒãlykt(ə)fɛmal] |
| tolerated | IP[ C$_2$ | *Jean-Luc, te fais pas mal!* | 'J., don't hurt yourself!' |
| ↓ | | /ʒãlyk t=fɛ pa mal/ | [ʒãlykt(ə)fɛpamal] |

(32)    EFFECT OF THE PRECEDING BOUNDARY WITH CLUSTER-MEDIAL FRICATIVES:

$k_{\,i}[\,s\,f],\ with\ i \in \{\ \emptyset, PW, ...IP\}$

| | | | |
|---|---|---|---|
| \| | ø[ C$_2$ | *il fait que se faire mal...* | 'he only hurts himself.' |
| cluster | | /il=fɛ k=s=fɛr mal/ | [tydik(ə)s(ə)fɛrmal] |
| more | MPP[ C$_2$ | *Jean-Luc se fait mal* | 'J. hurts himself' |
| easily | | /ʒãlyk s=fɛ mal/ | [ʒãlyks(ə)fɛmal] |
| tolerated | IP[ C$_2$ | *Jean-Luc, se faire mal...* | 'J., hurting oneself...' |
| ↓ | | /ʒãlyk s=fɛr mal/ | [ʒãlyks(ə)fɛrmal] |

(33)    PARTIAL GRAMMAR OF FRENCH (PRECEDING BOUNDARIES):

$$\emptyset[\text{stop} \leftrightarrow V$$

$\emptyset$[C $\leftrightarrow$V          PW[stop $\leftrightarrow$V          **DEP-V**

PW[C $\leftrightarrow$V          SPP[stop $\leftrightarrow$V

SPP[C $\leftrightarrow$V          MPP[stop $\leftrightarrow$V

MPP[C $\leftrightarrow$V          IP[stop $\leftrightarrow$V

IP[C $\leftrightarrow$V
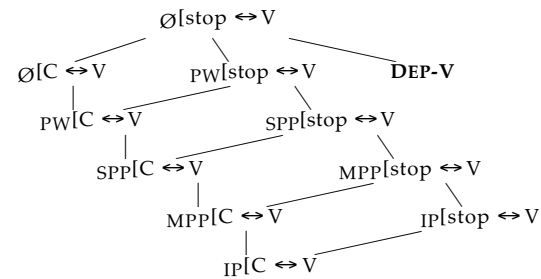
**5.3.3. STOP DELETION IN MARAIS-VENDÉEN**

Marais-Vendéen - a French dialect spoken in Western France - has a large set of words which appear with and without a final stop, especially [t], in different prosodic/grammatical contexts (Svenson 1959; Morin 1986). The stop is clearly retained before vowel-initial words and at the pause (therefore at least U-finally) (34).

(34)   FINAL STOP RETENTION PRE-PAUSALLY:
   a.   ptit ]U          →      no change        'small'
   b.   ʃat ]U           →      no change        'cat'
   c.   surt ]U          →      no change        'dumb'
   d.   hɛjt ]U          →      no change        'game'
   e.   lə mɑ̃ʒat ]U      →      no change        'they are eating'

But these final stops are generally omitted in preconsonantal position. These alternations originate from the Old French rule that productively deleted word-final stops (and non-strident fricatives) before consonant-initial words, while maintaining them phrase-finally and prevocalically (Morin 1986).[9] The interest of Marais-Vendéen, however, lies in the precise preconsonantal contexts that trigger deletion. Final stop deletion is attested in various syntactic contexts, illustrated in (35) with the words given in (34). These contexts are distinguished from subject+predicate sequences, in which Svenson (1959) reports no deletion. The example in (36) contrasts with that in (35b) in retaining the final [t] of /ʃat/ before a verbal group (including preverbal auxiliaries and clitics), as in (34b) above.

(35)   STOP DELETION ATTESTED:
   a.   Adj + noun:     [ɛ̃ pti pulan]          'a/one small colt'
                         *a/one small colt*
   b.   Noun + adj:     [ɛ̃ ʃa nwɛr]           'a/one black cat'
                         *a/one cat black*
   c.   Adj + PP:       [l ɛ sur km ɛ̃ pɔt]    'he's dumb like a pot'
                         *he is dum like a pot*
   d.   Noun + PP:      [ɛ̃ he d kart]          'a card game / card deck'
                         *a/one game of card*
   e.   Verb + object:  [lə mɑ̃ʒɑ̃ do patat]     'they are eating potatoes'
                         *they eat.3PL DET.IND.PL potatoes*

(36)   STOP DELETION UNATTESTED:
   Subject + verb:   [lə ʃat m at egrosinaj]    'the cat scratched me'
                      *the.MASC cat me has scratched*

Morin (1986) suggests about the absence of deletion in subject+verb sequences in Svenson's (1959) data that the relevant examples were obtained in slow speech, as deletion may be suppressed "whenever speakers slow down, or make a slight pause" (Morin 1986: 191). I would like to propose a different and more

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[9]This rule is at the origin of the process of 'liaison' in Modern French.

principled explanation. The example in (35a) involves a sequence of a noun preceded by an adjective of the restricted set of pre-nominal ones. Such sequences are always very closely related in French, syntactically and prosodically. The examples in (35b-e) all involve lexical maximal projections consisting of head-complement sequences: [Noun-AP]$_{NP}$ (35b), [Noun-PP]$_{NP}$ (35c), [Adj-PP]$_{AP}$ (35d), [V-NP]$_{VP}$ (35e). These sequences form smaller syntactic and prosodic units than subject-verb sequences (everything else being equal), however the syntax-prosody mapping operates (see Inkelas & Zec 1995 for a summary). In particular, objects are closer to the verb than subjects. A stronger prosodic boundary thus separates the verb from its subject (36) than from its object (35e). So in Marais-Vendéen, the prosodic boundary that separates the subject from its verb is strong enough to license word-final stops. Lower boundaries are not, which explains the contrast between (35) and (36).

For French, Selkirk (1986) and de Jong (1990, 1994) propose that an adjective is separated from a following noun by a simple PW boundary, and a noun from a following adjective by a SPP boundary. These are the syntax-prosody correspondences we used in the preceding section and in section 2.3.6. SSP boundaries actually have a wider distribution and appear between a lexical head and its complement, i.e. in all the contexts in (35b-e). In contrast, subjects are separated from the following predicate by at least a MPP boundary. If we follow the rules given above for Parisian French, we can formulate the generalization that, in Marais-Vendéen, stops delete when followed by a PW or SPP boundary, but are retained before a MPP or higher boundary. A formal analysis of stop deletion in this language along the line I have suggested involves the ranking in (37). The relevant faithfulness constraint is MAX-C/V__, as the deleted stop usually occurs in postvocalic position.

(37)   RANKING SPECIFIC TO MARAIS-VENDÉEN:
       stop]$_{PW}$→V >> stop]$_{SPP}$→V >> MAX-C/V__ >>
       stop]$_{MPP}$→V >> stop]$_{IP}$→V >> stop]$_U$→V

**5.3.4. EPENTHESIS IN VIMEU PICARD**

As French above, the variety of Picard spoken in Vimeu (northeastern France) displays cumulative edge effects, where more than one prosodic level are crucially involved, both domain-initially and domain-finally. Sequences of consonants are avoided by the insertion of the vowel [e] at morpheme junctures. This process has been described and analyzed in recent work by Julie Auger, in collaboration with Jeffrey Steele. I rely here on Auger (2000), Auger & Steele (1999), and Steele & Auger (1999). The interest of these data lies in particular in the

availability of a statistical analysis performed on a sizeable speech corpus. The results establish a convergence between real speech, monitored speech, as used by Dell (1977) for French (see chapter 2), and native intuitions in the description of edge effects. The Picard pattern, however, also reveals the possibility of epenthesis in certain contexts adjacent to a vowel, which is unpredicted in our approach as it is currently implemented.

Let us first look at the domain-initial facts. Words beginning in an underlying two-consonant sequence other than those composed of an obstruent followed by a liquid or glide alternate between [C₁C₂-] and [eC₁C₂-], depending on the preceding segmental and prosodic context. These clusters are of the type obstruent+nasal (e.g. /kminɛ/ 'chimney'), obstruent+obstruent, including /s/+stop (e.g. /dpi/ 'since'), or sonorant+obstruent, i.e. sequences of decreasing sonority (e.g. /rbeje/ 'watch, look'). Auger (2000) has performed a statistical analysis of these word-initial clusters in various prosodic positions. She has found that /e/-epenthesis is obligatory (with minor exceptions) IP-internally after a consonant-final word (38), and excluded after a vowel (39). The word-initial cluster appears in bold, the epenthetic vowels are underlined.

(38) OBLIGATORY EPENTHESIS IP-INTERNALLY AFTER A CONSONANT:
     a. /ɛ̃ mɔrsjø d **km**inɛ/    →    [ɛ̃mɔrsjød<u>e</u>**km**inɛ]   'a piece of chimney'
     b. /pur **km**ɛ̃ʃe/          →    [pur<u>e</u>**km**ɛ̃ʃe]        'to start'
     c. /sasir **dv**ã/           →    [sasir<u>e</u>**dv**ã]         'sit in front of'

(39) NO EPENTHESIS IP-INTERNALLY AFTER A VOWEL:
     a. /il ɑ **km**ɛ̃ʃɛ/    →    [ilɑ**km**ɛ̃ʃɛ] / *[ilɑ<u>e</u>**km**ɛ̃ʃɛ]   'he has started'
     b. /pasɛ **dv**ã/      →    [pɑsɛ**dv**ã] / *[pasɛ<u>e</u>**dv**ã]   'passed in front of'

The generalization underlying these facts is simple: IP-internally, consonants want to be adjacent to a vowel. When a three-consonant sequence is formed at word boundaries, epenthesis applies to provide the middle consonant ([k] in (38a-b), [d] in (38c)) with an adjacent vowel. When the word-initial consonant is already preceded by a vowel, there is no motivation for epenthesis. This follows straightforwardly from the ranking in (40), in which the constraint against epenthesis is ranked lower than the constraints requiring that every consonant preceded by a boundary lower than IP be adjacent to a vowel.

(40) RANKING SPECIFIC TO VIMEU PICARD:
     PW[C ↔V >> PP[C ↔V >> DEP-V

(41) EPENTHESIS IP-INTERNALLY IN VIMEU PICARD:

| /sasir **dv**ã/ | PW[C ↔V >> PP[C ↔V | DEP-V |
|---|---|---|
| sasir**dv**ã | (d) ! | |
| → sasir<u>e</u>**dv**ã | | * |
| /pasɛ **dv**ã/ | | |
| → pasɛ**dv**ã | | |
| pasɛ<u>e</u>**dv**ã | | * ! |

IP-initially (for example after a dislocated element) and U-initially, however, this absolute contrast between a preceding vowel and a preceding consonant disappears. Epenthesis is variable regardless of the preceding context. The examples below illustrate the optionality of initial /e/ after a consonant (42), a vowel (43), and in absolute initial position (44). They are given in their orthographic forms, with only the relevant cluster in phonological and phonetic representations.

(42) OPTIONAL EPENTHESIS IP- AND U-INITIALLY AFTER A CONSONANT:
     *qui dit Gnace, édvant / dvant partir*      'that he says Ignace, before leaving'
     /...s **dv**ã.../      →      [...s IP[(<u>e</u>)**dv**ã...]

(43) OPTIONAL EPENTHESIS IP- AND U-INITIALLY AFTER A VOWEL:
     *Il étouot bértcheu, dpis / édpis l'âge d'onze douze ans*
     'He was a shepherd, since the age of eleven twelve years old'
     /...berkø **dp**i.../    →    [...bertʃø IP[(<u>e</u>)**dp**i...]

(44) OPTIONAL EPENTHESIS U-INITIALLY IN ABSOLUTE INITIAL POSITION:
     a. *Dvant qu'éch co i cante*          'Before the cock crows'
         /**dv**ã.../          →    U[**dv**ã...]
     vs. *Edvant d'élver cho's séance*       'Before closing the meeting'
         /**dv**ã.../          →    U[<u>e</u>**dv**ã...]
     b. *J'sus garde-champête sermeinté*    'I am rural police officer certified'
         /**ʒ sy**.../          →    U[**ʃsy**...]
     vs. *Ej sus ein pige-moi-ça*         'I am in pajamas'
         /**ʒ sy**.../          →    U[<u>e</u>**ʒsy**...]

This is not to say that from the IP level up the strength of the prosodic boundary and the preceding segmental context have no more effect. Auger observed significant statistical differences between the IP and U levels and between the postvocalic, post consonantal, and absolute initial positions. The probabilities of epenthesis obtained by Auger for each context are given in the table below.

(45)    FREQUENCY OF EPENTHESIS IP- AND U-INITIALLY:

|        | IP-initially | U-initially |
|--------|--------------|-------------|
| V—     | 23%          | 36%         |
| C—     | 80%          | 57%         |
| Ø—     | N/A          | 43%         |
| Average | 47%         | 44%         |

First, the rate of epenthesis is quite high postconsonantally IP-initially (80%) but significantly lower U-initially (57%). This follows from the inherent ranking $_{IP}[C↔V >> _U[C↔V$. If DEP-V is unranked with respect to these two constraints, there are three possible rankings of these constraints: two of them generate epenthesis IP-initially ($_{IP}[C↔V>>_U[C↔V>>$DEP-V and $_{IP}[C↔V>>$DEP-V$>>_U[C↔V$); only one yields epenthesis U-initially ($_{IP}[C↔V>>_U[C↔V>>$DEP-V). The possibility of epenthesis after a vowel, however, is totally unexpected. Since a vowel is already present, there should not be any motivation for vowel insertion; yet it applies. And it is more likely at the U level than at the IP one.

The intuition behind these data seems fairly clear. A vowel across an IP or U boundary is "too far" from the consonant in need of an adjacent vowel. Markedness constraints that require consonants to appear next to a vowel then may not "see" the vowel across the boundary and trigger epenthesis. The probability that a vowel may not be seen by a constraint depends on the strength of the prosodic boundary that intervenes between the vowel and the consonant: the stronger the juncture, the farther the vowel, and the more likely to be violated the markedness constraint is. A vowel across an IP boundary is closer than one across a U boundary, hence the higher rate of epenthesis at the U level after a vowel: 36% vs. 23%. A vowel across a PP or lower boundary, however, always counts in the evaluation of the markedness constraints, as shown by the absence of epenthesis IP-internally after a vowel (39).

This uncovers a weakness in the constraint system that was designed: the markedness constraints C↔V and C→V do not take into consideration the proximity of the vowel. I do not propose a formal solution to this problem here, but notice that adding a proximity parameter to the constraint schema is clearly in the spirit of the general approach taken here: the farther the vowel, the less it affects the perceptibility of adjacent segments.

Let us now consider morpheme-final two-consonant clusters /-C$_1$C$_2$#/. Here we find that epenthesis before a consonant is obligatory PW-internally, for example in the compounds in (46). It is optional across a PW boundary (47), and excluded IP-finally (48).

(46)    OBLIGATORY EPENTHESIS PW-INTERNALLY:
   a. /burk+d+ɔ /           →        [burkedɔ]          'town of Ault'
   b. /pɔrt+bagaʒ/          →        [pɔrtebagaʒ]       'luggage rack'

(47)    OPTIONAL EPENTHESIS PW-FINALLY:
   a. *ch'qu'i s'in vo t'éte au juste d'éch Pèrc CanteRaine*
      'what CanteRaine Park will really look like'
                            /ʒyst d.../         →        [ʒyst]$_{PW}$ d..]
   vs. *assise justé dérriére éch chauffeur*
      'seated directly behind the driver'
                            /ʒyst d.../         →        [ʒyste]$_{PW}$ d..
   b. *Echl histoére a n'pérle point d'éch qu'il a pinsé*
      'The story doesn't tell us what he thought'
   vs.                      /perl p.../         →        [perl]$_{PW}$ p..]
      *édpi éne cope éd moés, o n'pérlé pu d'reuvrie*
      'People haven't talked about daydreaming for a couple of months'
                            /perl p.../         →        [perle]$_{PW}$ p..]

(48)    EPENTHESIS EXCLUDED IP- AND U-FINALLY:
   a. *in dirécte*        'in direct=live'    /ɛ̃direkt/   →    [ɛ̃direkt]
   b. *quê j'dorche*      'that I sleep+SUBJ'  /k ʒ dɔrʃ/   →    [keʒdɔrʃ]

The epenthesis patterns at both the right and left edges are generated by the constraint ranking in (49). This mini-grammar establishes three major zones with respect to /e/-insertion: obligatory epenthesis PW-internally and PW- and PP-initially, no epenthesis IP- and U-finally, and variable epenthesis PW- and PP-finally and IP- and U-initially.

(49)    PARTIAL GRAMMAR OF VIMEU PICARD:
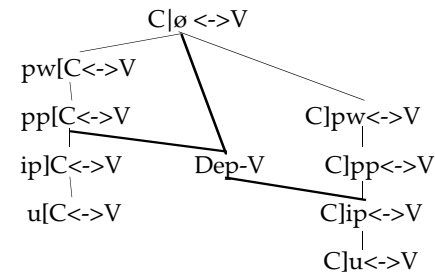
## 5.4 EPENTHESIS AND DELETION IN BASQUE

Basque, and specifically the Biscayan dialect spoken in Ondarroa (Spain), constitutes our final illustration of the desirability for consonants, especially non-edge ones, to appear next to a vowel.[10] This language displays cumulative edge effects as well as a contrast between stops/affricates and other consonants. Morpheme-final consonants, in particular stops and affricates, are subject to a number of processes to avoid appearing in non-prevocalic position: consonant deletion, vowel epenthesis, and affricate simplification. These processes become less likely to apply as we move from PW-internal positions to IP-final ones. But the application of these processes is subject to a lexical distinction between nouns/adjectives and closed-category lexical items, and to the status of the post-nominal singular marker /a/, which itself depends on the degree of opacity between singular and indefinite forms present in the inflectional system of the dialect.

I first present some basic facts regarding the phonemic inventory of Basque and the morphosyntactic contexts in which final stops and affricates are found in Basque, especially Ondarroa. A complete description and analysis of the Ondarroa variety then follows (sections 5.4.2 to 5.4.6). I end this chapter with a brief comparison of the Ondarroa facts with data from other dialects. The results support the approach taken here, against the OCP account to stop deletion that has become standard in the literature (5.4.7).

### 5.4.1. (ONDARROA) BASQUE: SOME BASIC FACTS

In this section I provide basic information on the grammar of Basque, which is necessary or useful to a proper understanding of the data presented in the following sections. More attention is given to Ondarroa Basque. I start with simple facts about the phonemic inventory and the phonotactics of the language, and go on with a presentation of the different words and contexts in which the relevant stops and affricates are found.

Most Basque dialects, including Ondarroa, have a simple five-vowel system /i,e,a,o,u/. A common consonantal inventory is given in (50) (from Hualde 1991: 10). Ondarroa Basque has a somewhat simpler inventory, as shown in (51):

(50)    COMMON BASQUE INVENTORY:      (51)    INVENTORY IN ONDARROA:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| p | t | | c | k | | p | t | | k |
| b | d | | ɟ | g | | b | d | | g |
| f | ç | s | ʃ | x | | f | | s | ʃ | x |
| | tç | ts | tʃ | | | | | tˢ | | tʃ |
| m | n | | ɲ | | | m | n | | ɲ |
| | l | | ʎ | | | | l | | ʎ/j |
| | ɾ | | | | | | ɾ | |
| | r | | | | | | r | |

One important difference between the inventories in (50) and (51) concerns the coronal fricatives and affricates. Many dialects have three series of coronal fricatives and affricates, detailed in (52):

(52)

| POINT OF ARTICULATION | PHONEMIC TRANSCIPTION | ORTHOGRAPHY |
|---|---|---|
| Apico-alveolar | /s/ - /tˢ/ | <s> - <ts> |
| Predorso-alveolar | /ç/ - /tç/ | <z> - <tz> |
| Palato-alveolar | /ʃ/ - /tʃ/ | <x> - <tx> |

In all Biscayan (including Ondarroa) and some Guipuscoan varieties, the contrast between apico-alveolar and predorso-alveolar fricatives and affricates has been lost. The unique non-palatal coronal fricative in Ondarroa is [s], whereas the corresponding affricate is [tç]. However, I represent both sounds by /s/ and /tˢ/, without indicating the articulatory distinction between the affricate and the fricative.[11] Also, the realization [j] in (51) results from the delateralisation of [ʎ] in younger Ondarroan speakers, including my informant (Hualde, p.c.)

Stems may end in one of the coronal sonorants (/n/, /l/, /r/-/ɾ/) and voiceless obstruents (/t/, /s/, /ʃ/, /tˢ/, /tʃ/). /ɲ/ is also possible in Ondarroa (as a result of palatalization). Some coronal clusters are also allowed stem-finally: /st/, /nt/, /ntˢ/, /ltˢ/, /rtˢ/. /k/ is not found in stem-final position but is frequent word-finally as part of a number of frequent affixes: e.g. ergative /-k/, absolutive plural /-ak/, ablative /-tik/.

Morpheme-final consonants, in particular stops and affricates, are subject to phonotactic processes when in contact with a following suffix or word. These are the contexts that are of interest to us. We can distinguish between major lexical

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[10]For the Basque data, I thank Ikuska Ansola for being such a good informant and José Ignacio Hualde for insightful comments on the data and the relevant literature. Thanks also go to Karlos Arregi for discussion on various aspects of the linguistic structure of Basque.

[11]I must mention that when affricates simplify, I do not know whether the resulting fricative is consistently apico- or predorso-alveolar. See Urrutia, Etxebarria & Duque (1988) for an acoustic analysis of sibilant consonants in Biscayan dialects.

categories and what I will refer to as "closed" categories. Nominal, adjectival, and verbal stems may end in a stop or affricate. Nominal and adjectival stems may be followed by a suffix or may surface in their bare form, when uninflected or before a null inflectional suffix. DPs are inflected for number and case; there are three numbers: singular, plural, and indefinite. The latter is used in particular in quantified contexts, with numerals and quantifiers. Inflectional markers appear only once, at the right edge of the DP. Nouns, adjectives, and other elements of nominal phrases thus appear in their bare form when not in DP-final position. Modifying adjectives follow the noun; the numerals *bat* 'one', which also functions as an indefinite determiner, and *bi* 'two'[12] follow both nouns and adjectives. Other numerals and determiners (demonstratives, quantifiers) precede the noun. Demonstratives are always inflected for case, even in pre-nominal position. DPs containing a demonstrative thus carry two inflectional markers, and are an exception to the above-mentioned rule. In Ondarroa (and Getxo; see Hualde & Bilbao 1992), the distinction between indefinite and other forms is maintained only in the absolutive case. The absolutive indefinite form of a noun or adjective is identical to its bare (uninflected) form.

Verbal stems are different from nominal and adjectival ones in that they never appear in their bare form, but only in one of their three participial forms, accompanied by an auxiliary. Only a handful of synthetic verbal forms depart from this rule. All participles end in a vowel or /n/ (not an obstruent), and are mostly irrelevant to the present study. As for the rules that govern the formation of the participial forms, by adding participial suffixes to the stem, they would require a separate study, which I will not undertake here. So verbs will not be considered, although it is already clear that adding them to our data set would not alter the conclusions of this investigation, as the same basic principles are operative in verbal and nominal morphology (see Hualde, Elordieta & Elordieta 1994 for a description of the verbal morphology in Lekeitio Basque, a dialect very close to Ondarroa).

In addition to the major lexical categories, there are a number of words in restricted categories that end in a stop. For Ondarroa, these include the numeral / determiner *bat* 'one', the numeral *bost* 'five', the quantifier *semat* 'how much / how many', some auxiliaries and synthetic verbal forms, e.g. *dot* 'transitive auxiliary, 1st sg. subject, 3rd sg. direct object', and *dakat* 'I have'. Inflectional affixes may also end in a stop, e.g. those ending in /k/ cited above. These can be added to nouns, adjectives, pronouns, and determiners. There is one inflectional suffix that ends in an affricate, the directional case marker /-ɾutˢ/. I have not investigated the behavior of

this final affricate in preconsonantal position, so only stops at the end of closed-category items will be described and analyzed.

To summarize, the behavior of morpheme-final stops and affricates will be investigated in the contexts given in (53), which leave aside verbal stems and the formation of participial forms as well as the directional suffix /ɾutˢ/. These contexts can be described in terms of two parameters: whether they are found in nouns/adjectives or in closed-category items, and whether they appear word-internally or finally.

(53)    CONTEXTS WITH MORPHEME-FINAL STOPS / AFFRICATES:
        Word-internally:
        a.  At the end of a nominal or adjectival stem, followed by an inflectional or derivational suffix
        Word- or phrase-finally:
        b.  At the end of the bare form of a noun or adjective (including its absolutive indefinite form)
        c.  • At the end of inflectional suffixes (stops only)
            • At the end of a number of closed-category lexical items (not nouns or adjectives) (stops only)

Since final affricates essentially only appear in nouns or adjectives, it follows that all the examples of affricate simplification found in the literature involve words in these two categories (contexts in (53a-b)). However, by contrast, almost all the examples of stop deletion involve words other than nouns and adjectives (contexts in (53c)). This can be explained by the fact that nominal and adjectival stems ending in a stop are fairly rare, much more so than those ending in an affricate. Moreover, some of the other words or morphemes ending in a stop are among the most frequent elements in the language, e.g. the absolutive plural and ergative case markers /-ak/ and /-k/ and the determiner *bat* 'one/a'.

This categorial distinction between examples with affricates and stops is not innocuous, as a more careful examination of stops in morpheme-final position shows that those in contexts (53b) do not behave like those in context (53c) (at least in Ondarroa). Therefore, any generalization mixing the contexts in (53b) and (53c) may be misleading. This is why in the rest of the discussion I treat nouns and adjectives separately from other categories, which I group under the label 'closed categories'.

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[12]This is true in Biscayan dialects. In other varities, *bi* behaves like other numerals and precedes the noun.

**5.4.2. STOPS AND AFFRICATES IN PREVOCALIC POSITION**

No change takes place when morpheme-final stops and affricates are followed by a vowel-initial word or suffix. No deletion, epenthesis, or any other strategies are used. This is illustrated in (54)-(57) for Ondarroa Basque, with stops in closed categories across word boundaries (54), and stops and affricates in nouns or adjectives before inflectional suffixes (55), derivational suffixes (56), and separate words (57).[13,14] The relevant consonants appear in boldface.

(54)    STOPS IN CLOSED CATEGORIES (ACROSS WORD BOUNDARIES):
   a.    /pijo ba**t** isot$^s$/              →        [pijoba**t**isot$^s$]
         *pile one ice.ABS.IND*
         'a lot of ice'
   b.    /ore-**k** at$^s$amar-ak dis/    →        [oreka**t**$^s$amaratis][15]
         *that-ERG.PL finger-ERG.PL are*
         'that's the fingers'

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[13]I use the following abbreviations and conventions for glosses:
• The lexical content is in lower-case, grammatical information in small capitals.
• Inflectional suffixes are separated from the stem by a hyphen "-"; derivational ones by "+".
• Abbreviations for suffixes:

| Case: | - ABS | absolutive | Number: | - SG | singular |
|-------|-------|------------|---------|------|----------|
|       | - ERG | ergative   |         | - PL | plural   |
|       | - DAT | dative     |         | - IND | indefinite |
|       | - ABL | ablative   |         |      |          |
|       | - GEN | genitive   | Derivational suffixes: | | |
|       | - DIR | directional |        | - SUPERL | superlative degree |
|       | - PROL | prolative |          | - COMP | comparative degree |
|       | - GEN LOC | genitive locative |  | - DIM  | diminutive |

• Abbreviations for verbal expressions:

| Verbs: | - PERF | perfective participle | | |
|--------|--------|-----------------------|---|---|
| Auxiliaries: | -AUX | auxiliary | - S | subject |
|        | - 1/2/3 | first/second/third person | - D | direct object |
|        | - SG/PL | singular/plural | - I | indirect object |

Basque has a very complex system of auxiliaries, which agree in person and number with the subject, direct object, and indirect object.
[14]In Basque, as in Spanish, voiced stops [b, d, g] have spirantized allophones [β, ð, ɣ]. Stops are found word-initially, after a nasal, and, for /d/, after a lateral. I disregard this allophonic distribution in the data, using only the symbols for voiced stops.
[15]Auxiliaries and synthetic verb forms cliticize onto the preceding word. If they begin in /b/ or /d/, devoicing applies when the preceding word ends in a voiceless consonant (even if this consonant deletes). See Arregi (1998) for an analysis of stop devoicing in auxiliaries in Ondarroa, and Gaminde (1998). /d/ in initial position of auxiliaries and synthetic forms also rhotacizes into [ɾ] intervocalically, for instance in (57b,d).

   c.    /basu-**k** eɾosi t∫us/              →        [basukeɾosit∫us]
         *glass-ABS.PL buy.PERF AUX.3SGS.3PLD*
         's/he has bought glasses'

(55)    STOPS/AFFRICATES IN NOUNS/ADJECTIVES BEFORE INFLECTIONAL SUFFIXES:
   a.    /koko**t**-an/            →        [koko**t**an]
         *neck-GEN.SG*
   b.    /ki∫ke**t**-a/            →        [ki∫ke**t**a]
         *lock-ABS.SG*
   c.    /bijo**t∫**-an/           →        [bijo**t∫**an]
         *lamb-GEN.SG*
   d.    /bal**t$^s$**-a/          →        [bal**t$^s$**a]
         *black-ABS.SG*

(56)    STOPS/AFFRICATES IN NOUNS/ADJECTIVES BEFORE DERIVATIONAL SUFFIXES:
   a.    /abera**t$^s$**+en/       →        [abera**t$^s$**en]
         *rich+SUPERL*
         'richest'
   b.    /ga**t∫**+ao/             →        [ga**t∫**ao]
         *difficult+COMP*
         'more difficult'
   c.    /galan**t**+en/           →        [galan**t**en]
         *beautiful/robust+SUPERL*
         'more beautiful/robust'
   d.    /galan**t**+ao/           →        [galan**t**ao]
         *beautiful/robust+COMP*
         'most beautiful/robust'

(57)    STOPS/AFFRICATES IN NOUNS/ADJECTIVES ACROSS WORD BOUNDARIES:
   a.    /ki∫ke**t** andi bat/     →        [ki∫ke**t**andibat]
         *lock big one.ABS*
         'a/one big lock'
   b.    /iɾu t∫ikot eɾosi dot/    →        [iɾut∫ikoteɾosiɾot]
         *three rope.ABS.IND buy.PERF AUX.1SGS.3SGD*
         'I have bought three ropes'
   c.    /eska**t$^s$** andi bat/  →        [eska**t$^s$**andibat]
         *kitchen big one.ABS*
         'a/one big kitchen'

    d. /lau sit**s** eɾosi dot/         →       [lausit**s**eɾosiɾot]
    *four woodworm.ABS.IND buy.PERF AUX.1SGS.3SGD*
    'I have bought four woodworms'

It has been established that final stops and affricates are always licensed before a vowel. When no vowel follows, a variety of processes may apply, depending on a number of factors:
• whether it is a stop or an affricate;
• whether the stop/affricate is part of a closed-category item or a noun/adjective;
• what prosodic boundary, if any, follows the stop / affricate.
I look at closed-category items and nouns/adjectives separately, starting with the former group. In both groups a major distinction is found at the IP level, between IP-internal and IP-final segments. For nouns/adjectives, PW-internal stops and affricates also contrast with PW-final ones.

**5.4.3. DELETION IN CLOSED-CATEGORY LEXICAL ITEMS**

**5.4.3.1. IP-internal deletion**

IP-internally, final stops in closed-category lexical items are generally characterized by their instability in pre-consonantal position. They easily delete in this context, but this is not obligatory. Final stops can also be pronounced in a reduced form, as an unreleased stop, a weak fricative, or a glottal stop, in part depending on the following segment. But deletion remains the most frequent strategy. It takes place before any following consonant: stops (58), affricates (59), nasals (60), fricatives (61), laterals (62), and rhotics (63). The optionality of stop deletion is indicated with parentheses. The reason why I am giving examples of each type of consonants will become clear when we discuss cross-dialectal data, as deletion is blocked in other dialects before certain consonants (section 5.4.7).

(58)    BEFORE STOPS:
    a. /ore-**k** paper-ak dis/     →     [ore(**k**)paperatis]
    *that-ERG.PL papers-ERG.PL are*
    'that's the papers'
    b. /giʃon-a**k** topa dau/     →     [giʃona(**k**)topaɾau]
    *man-ERG.SG find.PERF AUX.3SGS.3SGD*
    'the man has found it/him/her'
    c. /liburu ba**t** galdu dot/     →     [liburuba(**t**)galduɾot]
    *book one.ABS lose.PERF AUX.1SGS.3SGD*
    'I have lost a book'

(59)    BEFORE AFFRICATES:
    a. /sema**t** tʃakur/         →     [sema(**t**)tʃakur]
    *how many dog.ABS.IND*
    'how many dogs'
    b. /ore-**k** tʃakur-ak dis/     →     [ore(**k**)tʃakuratis]
    *that-ERG.PL dog-ERG.PL are*
    'that's the dogs'
    c. /at**s**amar ba**t** tʃupa dot/   →    [at**s**amarba(**t**)tʃupaɾot]
    *finger one.ABS suck.PERF AUX.1SGS.3SGD*
    'I have sucked a pencil'

(60)    BEFORE NASALS:[16]
    a. /sema**t** mutil/         →     [sema(**t**)mutil]
    *how many boy.ABS.IND*
    'how many boys'
    b. /basu-**k** nai tʃus/     →     [basu(**k**)naitʃus]
    *glass-ABS.PL want.PERF AUX.3SGS.3PLD*
    's/he has wanted glasses'
    c. /giʃon ba**t** mima dau/     →     [giʃomba(**t**)mimaɾau]
    *man one.ABS mime.PERF AUX.3SGS.3SGD*
    's/he has mimed a man'

(61)    BEFORE FRICATIVES:
    a. /ore-**k** sagusar-ak dis/   →    [ore(**k**)sagusaratis]
    *that-ERG.PL bat-ERG.PL are*
    'that's the bats'

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[16]Rotaetxe (1978) mentions that stop deletion occurs before stops and fricatives, but not nasals, in Ondarroa. She provides the following examples to illustrate stop retention in this context:
(i)   a.   &lt;bado<u>t meriku</u> on bat...&gt;     /t m/ →    [tm]    'I have a good doctor'
     b.   &lt;daka<u>t naigabe</u> andixe...&gt;   /t n/ →    [tn]    'I have a big disgust'
     c.   &lt;tresna<u>k mai</u> gamin...&gt;     /k m/ →   [km]    'the dishes on the table'
     d.   &lt;okana<u>k nai</u>...&gt;           /k n/ →    [kn]    'to want cherries'
My own experience does not confirm this contrast between nasals and other consonants, and I cannot explain Rotaetxe's data. Recall that stop deletion is not obligatory, so the examples in (i) are not problematic in themselves. Notice, however, that the first two sentences are puzzling for reasons independent from stop deletion. They are considered ungrammatical by my informant. First, the verbal form *dot* in (a) (preceded by the emphatic particle *ba*) is only used as an auxiliary in Ondarroa and cannot mean 'I have' (as is possible in other – non-Biscayan – varieties). Second, a sentence cannot begin with an inflected verb as in (b); the emphatic particle *ba* has to be prefixed to it. As for the sentences in (c-d), my informant does not agree with Rotaetxe on the obligatoriness of stop retention.

b.  /ore-**k** familiʃa-k dis/          →          [ore(**k**)familiʃatis]
   *that-ERG.PL family-ERG.PL are*
   'that's the families'

c.  /sema**t** sagusar/               →          [sema(**t**)sagusar]
   *how many bat.ABS.IND*
   'how many bats'

d.  /sema**t** familiʃa/             →          [sema(**t**)familiʃa]
   *how many family.ABS.IND*
   'how many families'

e.  /sema**t** xeneral/              →          [sema(**t**)xeneral]
   *how many general.ABS.IND*
   'how many generals'

f.  /gu-**k** sartu dou/             →          [gu(**k**)sarturou]
   *we-ERG put in.PERF AUX.1PLS.3SGD*
   'we have put it/her/him in'

g.  /gu-**k** fiʃa ga/               →          [gu(**k**)fiʃaga]
   *we-ERG trust.PERF AUX.1PLS*
   'we have trusted'

(62)   BEFORE LATERALS:
a.  /gu-**k** lortu dou/             →          [gu(**k**)lorturou]
   *we-ERG get.PERF AUX.1PLS.3SGD*
   'we have gotten it/him/her'

b.  /baso ba**t** lortu dau/          →          [basoba(**t**)lorturau]
   *glass one.ABS get.PERF AUX.3SGS.3SGD*
   's/he has gotten a glass'

c.  /sema**t** lapitˢ/               →          [sema(**t**)lapitˢ]
   *how many pencil.ABS.IND*
   'how many pencils'

(63)   BEFORE RHOTICS:
a.  /ore-**k** radiʃu-k dis/          →          [ore(**k**)radiʃutis]
   *that-ERG.PL radio-ERG.PL are*
   'that's the radios'

b.  /sema**t** radiʃo/              →          [sema(**t**)radiʃo]
   *how many radio.ABS.IND*
   'how many radios'

c.  /gu-**k** rosa dou/             →          [gu(**k**)rosarou]
   *we-ERG get together.PERF AUX.1PLS.3SGD*
   'we have gotten together'

There is evidence that the stop may indeed be completely deleted in preconsonantal position. Compare the two sentences in (64), which differ only by the inflectional marker on the noun. In (64a), *giʃon* 'man' is the subject of the sentence and carries the ergative case /-ak/. In (64b), *giʃon* is the object and appears with the absolutive case /-a/.

(64)   COMPLETE DELETION OF WORD-FINAL /-k/:
a.  /giʃon-a**k** topa dau/          →          [giʃonatoparau]
   *man-ERG.SG find.PERF AUX.3SGS.3SGD*
   'the man has found it/her/him'

b.  /giʃon-a topa dau/              →          [giʃonatoparau]
   *man-ABS.DEF.SG find.PERF AUX.3SGS.3SGD*
   's/he has found the man'

The sentences in (64a) and (64b) were recorded by my informant. Both were then randomly played to her, and she had to tell whether 'the man' was the subject or the object of the sentence. Interestingly, she was wrong or could not tell in all cases, which strongly suggests that the deletion of the stop is complete in sentences like (64). No apparent perceptual cues to the underlying /k/ remain in (64a).

### 5.4.3.2. IP-final retention

By contrast, IP- and U-final stops never delete, as shown in (65a) and (66). In the sentence in (65a), the object has been fronted and is separated from the rest of the sentence by an IP boundary. This example minimally differs from (65b), which uses the neutral SOV order, in which both noun phrases appear IP-internally. In (66) each example corresponds to an utterance, so the final stops are followed by a U boundary.

(65)   NO STOP DELETION IP-FINALLY:
a.  /prak-a**k** giʃon-ak erosi dau/ → [praka**k**]ᵢₚ giʃonakerosirau]
   *pants-ABS man-ERG buy AUX.3SGS.3SGD*          (*prakak* left-dislocated)
   'pants, the man has bought'

b.  /giʃon-a**k** prak-ak erosi dau/ → [giʃona(**k**)prakakerosirau]
   *man-ERG pants-ABS buy AUX.3SGS.3SGD*          (*giʃonak* not left-dislocated)
   'the man has bought pants'

(66)   NO STOP DELETION U-FINALLY:
a.  /sema**t**/                     →          [sema**t**] *[sema]
   'how much / how many'

  b. /libuɾu bat/   →  [libuɾubat] *[libuɾuba]
    *book one.ABS*
    'a book'

  c. /iɾu oratˢ eɾosi dot/ →  [iɾuoratˢeɾosiɾot] *[iɾuoratˢeɾosiɾo]
    *three comb.ABS.IND buy.PERF AUX.1SGS.3SGD*
    'I have bought three combs'

  d. /ore-k umi-**k**/  →  [orekumi**k**] *[orekumi]
    *that.ABS.PL child.ABS.PL*
    'those children'

The contexts for mandatory and optional stop retention are not to be distinguished by whether a consonant or a pause follows. Dislocated elements and IP boundaries are not necessarily separated by a pause from the rest of the sentence. Although the claim is often made that dislocation is characterized by the presence of a pause, more careful phonetic studies always indicate that this is not the case; see Dubuisson et al. (1983), Barnes (1985), Dupont (1985), and Deshaies et al. (1992) about left-dislocation in French. I have not conducted an experimental study of the intonation of dislocation in Ondarroa Basque, but my judgments corroborate those obtained for French.

So whether or not word-final stops in closed categories delete is determined by their position within IPs. IP-final stops do not delete, whether a vowel, a consonant, or a pause follows; IP-medial ones are optionally dropped when they are not followed by a vowel.

### 5.4.4. EPENTHESIS AND SIMPLIFICATION IN NOUNS/ADJECTIVES

Stops and affricates at the end of nouns and adjectives differ in two respects from stops in closed categories. First, they appear word-internally before suffixes, which allows us to extend our investigation to word-internal contexts. It is observed that word-internal stops and affricates are even more restricted than word-final ones, which follows in the most natural way from the perceptual approach to consonant licensing argued for in this thesis. Second, stops in nouns/adjectives never delete; they are prevented from appearing in non-prevocalic position by other strategies: affricate simplification and insertion of the marker /a/ in contexts where it is not otherwise expected. These two processes are unavailable with closed categories since, for the most part, affricates are not found in final position in this group, and the /a/ marker, discussed in the section to come, is used only with nouns and adjectives.

I again present the data according to the prosodic context in which the final stop/affricate occurs: PW-internally, IP-internally, and IP-finally. But before we move on to the description of consonant-final nouns and adjectives, a discussion of some aspects of the nominal inflectional system of Ondarroa, as opposed to other dialects, is necessary in order to understand the nature of the marker /a/. We will see that the structure of the inflectional system interacts in interesting ways with phonotactic constraints, with distinct effects in different dialects, depending on the relative opacity of the singular/indefinite distinction in the system.

#### 5.4.4.1. Excursus on the inflectional system

Most Basque dialects maintain a distinction between singular, plural, and indefinite forms for each case (except prolative and partitive, which have only one form). The structure of inflected nouns is [stem+number marker+case marker]; the singular marker is /a/ and the plural one /a(k)/[17]; the indefinite marker is phonetically null. So, for the most part, singular and indefinite forms differ in that the former carries a marker /a/ that is missing in the latter. When consonant-final stems and consonant-initial case markers come in contact in the indefinite form, an epenthetic vowel /e/ is inserted. The marker /a/ also raises to [e] when the last vowel of the stem is high, so that for these stems there is no distinction between the indefinite and singular forms with consonant-initial case endings (e.g. [lagunek] for both ergative sg. and ind. (67c) vs. [giʃonek] for erg. ind. and [giʃonak] for erg. sg. (67a)). The following examples for the stem *giʃon* 'man', *baso* 'forest', and *lagun* 'friend' are taken from the dialect spoken in Gernika. Note that the absolutive case marker is phonetically null.

(67) ABSOLUTIVE AND ERGATIVE IN GERNIKA (Hualde & Bilbao 1992):

|  |  | *indefinite* |  | *singular* |  |
|---|---|---|---|---|---|
| a. | absolutive | giʃon-Ø-Ø | [giʃon] | giʃon-a-Ø | [giʃona] |
|  | ergative | giʃon-Ø-k | [giʃonek] | giʃon-a-k | [giʃonak] |
| b. | absolutive | baso-Ø-Ø | [baso] | baso-a-Ø | [basoa] |
|  | ergative | baso-Ø-k | [basok] | baso-a-k | [basoak] |
| c. | absolutive | lagun-Ø-Ø | [lagun] | lagun-a | [lagune] |
|  | ergative | lagun-Ø-k | [lagunek] | lagun-a-k | [lagunek] |

Certain dialects, including Ondarroa (Hualde 1995) and Getxo (Hualde & Bilbao 1992), have lost the indefinite-singular distinction in all the cases but the absolutive. This has come as a consequence of the acquisition of a vowel deletion

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[17]Plural forms are often segmentally identical to singular ones, but the two differ on the position of the accent: singular suffixes are unaccented, while plural ones are pre-accented.

rule that has removed the singular marker after another vowel. This process has affected stems ending in a vowel, like *baso* 'forest', *mendi* 'mountain', *neska* 'girl'. The loss of the marker /a/ in a large proportion of nouns/adjectives has made its interpretation more opaque, so that now it only plays a role in the most common case - the absolutive - which is used for objects and subjects of intransitive verbs (the absolutive singular is also the citation form). The partial declensions corresponding to (67) in the Getxo and Ondarroa varieties are given below (see Hualde & Bilbao 1992 and Hualde 1995 for the complete paradigms).

(68)    ABSOLUTIVE AND ERGATIVE IN GETXO (Hualde & Bilbao 1992):

|  |  | indefinite | indefinite/singular | singular |
|---|---|---|---|---|
| a. | absolutive | [gison] |  | [gisona] |
|  | ergative |  | [gisonak] |  |
| b. | absolutive |  | [baso] |  |
|  | ergative |  | [basok] |  |
| c. | absolutive | [lagun] |  | [lagune] |
|  | ergative |  | [lagunek] |  |

(69)    ABSOLUTIVE AND ERGATIVE IN ONDARROA (Hualde 1995):

|  |  | indefinite | indefinite/singular | singular |
|---|---|---|---|---|
| a. | absolutive | [giʃon] |  | [giʃona] |
|  | ergative |  | [giʃonak] |  |
| b. | absolutive | [baso] |  | [basu] |
|  | ergative |  | [basuk] |  |
| c. | absolutive | [lagun] |  | [lagune] |
|  | ergative |  | [lagunak] |  |

There is, however, one important difference between Getxo and Ondarroa. In Getxo, as a consequence of the deletion rule, absolutive singular and indefinite forms have become identical for most vowel-final stems. The distinction is consistently marked only for consonant-final stems, e.g. *gison* 'man' and *lagun* 'friend'. In Ondarroa, on the other hand, a series of processes affecting vowel sequences have left their trace on the stem-final vowel before the singular marker deleted, notably vowel raising and /ʃ/-insertion. As a consequence absolutive indefinite and singular forms are different for most vowel-final stems, although the distinction is not made by the addition of /a/, as in consonant-final stems, but by raising the stem vowel or by inserting [ʃ], as in [mendiʃe] (70c). See the examples below for both dialects.

(70)    ABSOLUTIVE CASE IN GETXO AND ONDARROA:

|  | | Getxo | | Ondarroa | |
|---|---|---|---|---|---|
|  |  | Indefinite | Singular | Indefinite | Singular |
| a. | 'forest' | baso | baso | baso | basu |
| b. | 'house' | etˢe | etˢe | etʃe | etʃi |
| c. | 'mountain' | mendi | mendi | mendi | mendiʃe |
| d. | 'girl' | neska | neske/neska | neska | neski |

The changes that the Getxo and Ondarroa dialects have undergone have had important consequences outside of the inflectional system itself. First, the marker /a/ is no longer consistently interpreted as a singular marker. So the absolutive singular form is now being used in contexts where the indefinite one is expected. As a further step, /a/ is also on its way to even losing its suffixal status, forms in /a/ being used in place of the uninflected ones, i.e. as non-final elements inside DPs. What we seem to witness is the emergence of stem allomorphy between the /a/-final and consonant-final forms. This is particularly true in Getxo, where the blurring of the indefinite and singular forms is more advanced (see the discussion in Hualde & Bilbao 1992).

This reinterpretation of the formally singular forms in /a/ has affected the treatment of stem-final stops and affricates in Ondarroa and Getxo. The /a/-final forms are now being used to break up the disprefered or impossible consonant sequences which the use of the consonant-final form would have created. So /a/ plays the role of an epenthetic vowel, restricted to nouns and adjectives (it cannot be used with e.g. closed-category items ending in a stop). We will see plenty of examples of this use in the sections below. The behavior of final consonants in Ondarroa can most relevantly be compared with that in the Lekeitio variety, where the use of a proxy /a/ marker does not seem to be attested. This dialect, otherwise very close to Ondarroa, has fully retained the distinction between indefinite and singular forms in all cases, and consequently has maintained a consistent interpretation of /a/ as a singular marker.

### 5.4.4.2. PW-internal contexts

Let us first look at stem-final stops and affricates at PW-internal morpheme boundaries. The general rule, both before inflectional and derivational suffixes, is that stops and affricates cannot surface before a consonant. The choice of /a/-final forms represents the main strategy used to prevent this undesired situation, but affricate simplification is also possible. Insertion of a truly epenthetic vowel /e/ is also attested in restricted and frozen contexts, but seems to be no longer productive.

Inflectional suffixes fall under two categories: locative and nonlocative. Apart from the prolative, nonlocative cases are irrelevant here since they all begin in a vowel, or automatically take the marker /a/ between the stem and the case ending proper. The prolative is different in that it makes no number distinction, and the case marker /-tˢat/ attaches directly to the stem. The consonant-initial locative suffixes include the genitive locative /-ko/, the ablative /-tik/, and the directional /-ɾutˢ/. In most dialects, locative cases do not take the marker /a/; an epenthetic vowel always appears between consonant-final stems and consonant-initial suffixes, irrespective of the nature of these consonants. In Ondarroa, we observe the first effect of the reinterpretation of the marker /a/. Unlike most dialects (e.g. Lekeitito), which only use true epenthesis after consonant-final stems, Ondarroa oscillates between epenthesis and the addition of the marker /a/, as shown in (71)-(73). It appears that the structure of locative cases is being reanalyzed to make it more like that of non-locative forms, so that the /a/ marker, which is used in all non-locative cases, now tends to be prefered over epenthesis in locative cases as well. The same process replacing epenthesis with the marker /a/ is attested, in a more advanced form, in Getxo, where /a/ is now the only vowel used.

(71) AFFRICATE-FINAL STEMS + LOCATIVE INFLECTIONAL SUFFIXES:
 a. /biʃotˢ-ko/ → [biʃotˢeko] 'heart-GEN LOC'
 b. /bijotʃ-tik/ → [bijotʃetik] 'lamb-ABL'
 c. /eskatˢ-ɾutˢ/ → [eskatˢeɾutˢ] / [eskatˢaɾutˢ] 'kitchen-DIR'

(72) STOP-FINAL STEMS + LOCATIVE INFLECTIONAL SUFFIXES:
 a. /kokot-tik/ → [kokotetik] / [kokotatik] 'neck-ABL'
 b. /silbot-ɾutˢ/ → [silbotaɾutˢ] 'prominent belly-DIR'
 c. /apart-ɾutˢ/ → [apartaɾutˢ] 'excellent-DIR'

(73) STEMS ENDING IN OTHER CONSONANTS + LOCATIVE INFLECTIONAL SUFFIXES:
 a. /asal-tik/ → [asaletik] 'skin-ABL
 b. /adar-tik/ → [adaretik] / [adaratik] 'branch/horn-ABL'
 c. /iʃen-tik/ → [iʃenetik] / [iʃenatik]¹⁸ 'name-ABL'
 d. /araiɲ-tik/ → [araiɲatik] / *[araiɲetik] 'fish-ABL'
 e. /lanbas-tik/ → ?[lambasetik] / [lambasatik] 'mop-ABL'
 f. /tʃiʃ-tik/ → [tʃiʃetik] 'urine-ABL'
 g. /lanbas-ɾutˢ/ → [lambasaɾutˢ] 'mop-DIR'

¹⁸Stems ending in a nasal may also in certain cases form the ablative without the epenthetic vowel, but with voicing of the suffix-initial /t/: [araindik] 'fish', ?[iʃendik] 'name', [asafrandik] 'safran'. I do not know what factors are involved in the possibility of using this exceptional process.

These inflectional suffixes do not tell us anything about the particular behavior of stops and affricates since epenthesis occurs after all consonants. But they do point to the general preference for open syllables in Basque, as well as to the reanalysis of the /a/ marker. I will not consider these affixes in the rest of the analysis.

The prolative suffix /-tˢat/, unlike those illustrated in (71)-(73), does not normally trigger epenthesis when attached to a consonant-ending stem in other dialects (e.g. Lekeitio in Hualde, Elordieta & Elordieta 1994).¹⁹ But the partial reanalysis that has extended the use of the marker /a/ in the inflectional paradigm makes it also available in the prolative. Interestingly the use of /a/ seems to be linked to the sonority of the stem-final consonant: the less sonorous it is, the more likely it is for /a/ to be used. Stems ending in /r/ are incompatible with the vocalic marker (74a-b)²⁰, those ending in a nasal accept both the forms with direct addition of the suffix and insertion of /a/ (74c), those ending in a fricative slightly favor the use of the vowel (74d-e).

(74) STEMS ENDING IN OTHER CONSONANTS + PROLATIVE CASE:
 a. /atˢamar-tˢat/ → [atˢamartˢat] / *[atˢamaratˢat] 'finger-PROL'
 b. /likor-tˢat/ → [likortˢat] / *[likoratˢat] 'liquor-PROL'
 c. /giʃon-tˢat/ → [giʃontˢat] / [giʃonatˢat] 'man-PROL'
 d. /xues-tˢat/ → ?[xuestˢat] / [xuesatˢat] 'judge-PROL'
 e. /frantˢes-tˢat/ → ?[frantˢestˢat] / frantˢesatˢat 'Frenchman-PROL'

With stems ending in a stop or an affricate, the situation is clear: the /a/-final form is required in all cases (75)-(76).

(75) AFFRICATE-FINAL STEMS + PROLATIVE CASE:
 a. /lapitˢ-tˢat/ → [lapitˢatˢat] 'pencil-PROL'
 b. /arotˢ-tˢat/ → [arotˢatˢat] 'carpenter-PROL'
 c. /sotˢ-tˢat/ → [sotˢatˢat] 'toothpick-PROL'

¹⁹But the examples given in Hualde et al. (1994) involve stem-final consonants that are attested in coda position stem-internally. It is not clear what happens with stop- and affricate-final stems, these consonants never appearing in internal codas.

²⁰An exception is /ur/ 'gold', whose prolative form is [uretˢat] rather than [urtˢat]. Notice that /ur/ contrasts with /uɾ/ 'water', whose prolative form is [uɾetˢat]. The flap and the trill only contrast in intervocalic position, rhotics being trilled in other positions. The /a/-final form could then be favored here to preserve the distinction between the two rhotics. (Recall that /a/ raises to [e] after high vowels, although I have found that this is not consistently done by my informant.)

  d.  /eskat**s**-t**s**at/   →   [eskat**s**<u>a</u>t**s**at]   'kitchen-PROL'
  e.  /at͡ʃ-t**s**at/   →   [at͡ʃ<u>a</u>t**s**at]   'rock-PROL'
  f.  /bijot͡ʃ-t**s**at/   →   [bijot͡ʃ<u>a</u>t**s**at]   'lamb-PROL'

(76)  STOP-FINAL STEMS + PROLATIVE CASE:
  a.  /kiʃket-t**s**at/   →   [kiʃket<u>a</u>t**s**at]   'lock-PROL'
  b.  /kokot-t**s**at/   →   [kokot<u>a</u>t**s**at]   'neck-PROL'
  c.  /apart-t**s**at/   →   [apart<u>a</u>t**s**at]   'excellent-PROL'
  d.  /galant-t**s**at/   →   [galant<u>a</u>t**s**at]   'elegant / robust-PROL'

The situation in derivational morphology is slightly more complex.[21] Neither affricates nor stops are allowed before consonant-initial derivational suffixes, as before the prolative suffix /-t**s**at/. Vowel insertion is the most general strategy used to prevent this situation, but simplification into a fricative is also an option for affricates. True epenthesis is well attested in the established vocabulary, but the use of the /a/-final form is now prefered in the more productive morphology.

With the verbalizing suffix /-tu/, usually only one form is good, although with [abeɾat**s**] (77a) and [lat**s**] (77b), both epenthesis and simplification are acceptable. Here the epenthetic vowel is /e/ or /i/, /t/ palatalizing into [t͡ʃ] when the latter is used. Which repair strategy is to be prefered does not seem to be predictable from the shape of the stem, cf. for example the contrast between [mostu] (77c) and [ot**s**it͡ʃu] (77g).

(77)  AFFRICATE-FINAL STEMS + SUFFIX /-tu/:
  a.  /abeɾat**s**+tu/   →   [abeɾat**s**<u>i</u>t͡ʃu] / [abeɾastu]   'to become rich'
  b.  /lat**s**+tu/   →   [lat**s**<u>e</u>tu / lastu]   'to become rough'
  c.  /mot**s**+tu/   →   *[mot**s**<u>i</u>t͡ʃu] / [mostu]   'to shorten'
  d.  /sorot**s**+tu/   →   *[sorot**s**<u>i</u>t͡ʃu] / [sorostu]   'to sharpen'
  e.  /garat**s**+tu/   →   *[garat**s**<u>i</u>t͡ʃu] / [garastu]   'to become sour'
  f.  /orat**s**+tu/   →   *[orat**s**<u>i</u>t͡ʃu] / [orastu]   'to comb'
  g.  /balt**s**+tu/   →   [balt**s**<u>i</u>t͡ʃu] / *[balstu]   'to blacken'
  h.  /ot**s**+tu/   →   [ot**s**<u>i</u>t͡ʃu] / *[ostu]   'to get cold'
  i.  /gat͡ʃ+tu/   →   ??[gat͡ʃ<u>e</u>tu] / *[gaʃtu]   'to get difficult'

---

[21]Very few derivational suffixes are productive enough to be freely associated with a reasonable number of stems ending in affricates and stops. The most productive one is the diminutive suffix /-t͡ʃo/. Also useful is the adjectival suffix /-sale/ 'fond of'. The verbalizing suffix /-tu/ appears in a large number of items but its synchronic productivity is limited.

But I have found this suffix to have very limited synchronic productivity, other strategies being prefered to form verbs from nouns and adjectives (in particular the use of a dummy verb meaning 'do'). Other examples of affricate-final stems followed by suffixes with null or limited synchronic productivity are given in (78). Two of the forms involve simplification, the other one epenthesis.

(78)  AFFRICATE-FINAL STEMS + OTHER (UNPRODUCTIVE) DERIVATIONAL SUFFIXES:
  a.  /biʃot**s**+dun/   →   [biʃosdun]   'courageous'
  b.  /orat**s**+keri/   →   [oraskeri]   'hair style'
  c.  /maʃat**s**+ro/   →   [maʃat**s**<u>e</u>ro]   'every May'

With synchronically fully productive suffixes, in particular the diminutive /-t͡ʃo/, but also /-sale/, the vowel used is always /a/, never /e/. So there is only one possible output when this suffix is added to stop-final stems (79).

(79)  STOP-FINAL STEMS + SUFFIXES /-t͡ʃo, -sale/:
  a.  /kokot+t͡ʃo/   →   [kokot<u>a</u>t͡ʃo]   'neck+DIM'
  b.  /kiʃket+t͡ʃo/   →   [kiʃket<u>a</u>t͡ʃo]   'lock+DIM'
  c.  /kaset+t͡ʃo/   →   [kaset<u>a</u>t͡ʃo]   'cassette+DIM'
  d.  /t͡ʃalet+t͡ʃo/   →   [t͡ʃalet<u>a</u>t͡ʃo]   'chalet+DIM'
  e.  /t͡ʃalet+sale/   →   [t͡ʃalet<u>a</u>sale]   'fond of chalets'

With affricates, the form with the /a/-final stem is always acceptable, while the one with simplification of the affricate is more variable. While it is fully grammatical in some words (80a-c, m), it is impossible or very marginal in others (80f-l). Nothing special needs to be said about /-sale/ (81), apart from the fact that it is not clear whether the fricative resulting from the simplification of the affricate forms or not a geminate with the following /s/-initial suffix.

(80)  AFFRICATE-FINAL STEMS + SUFFIX /-t͡ʃo/:
  a.  /lapit**s**+t͡ʃo/   →   [lapit**s**<u>a</u>t͡ʃo] / [lapist͡ʃo]   'pencil+DIM'
  b.  /sit**s**+t͡ʃo/   →   [sit**s**<u>a</u>t͡ʃo] / [sist͡ʃo]   'woodworm+DIM'
  c.  /sot**s**+t͡ʃo/   →   [sot**s**<u>a</u>t͡ʃo] / [sost͡ʃo]   'toothpick+DIM'
  d.  /arit**s**+t͡ʃo/   →   [arit**s**<u>a</u>t͡ʃo] / (?)[arist͡ʃo]   'oak tree+DIM'
  e.  /ot**s**+t͡ʃo/   →   [ot**s**<u>a</u>t͡ʃo[ / ?[ost͡ʃo]   'cold+DIM'
  f.  /orat**s**+t͡ʃo/   →   [orat**s**<u>a</u>t͡ʃo] / ??[orast͡ʃo]   'comb+DIM'
  g.  /eskat**s**+t͡ʃo/   →   [eskat**s**<u>a</u>t͡ʃo] / ??[eskast͡ʃo]   'kitchen+DIM'
  h.  /aberat**s**+t͡ʃo/   →   [aberat**s**<u>a</u>t͡ʃo] / ??[aberast͡ʃo]   'old+DIM'
  i.  /aut**s**+t͡ʃo/   →   [aut**s**<u>a</u>t͡ʃo] / ??[aust͡ʃo]   'dirt+DIM'

    j. /gilt<sup>s</sup>+tʃo/ → [gilt<sup>s</sup>atʃo] / *[gilstʃo] 'key+DIM'
    k. /irunt<sup>s</sup>+tʃo/ → [irunt<sup>s</sup>atʃo] / *[irunstʃo] 'dew+DIM'
    l. /atʃ+tʃo/ → [atʃatʃo] / *[aʃtʃo] 'rock+DIM'
    m. /bijotʃ+tʃo/ → ?[bijotʃatʃo] / [bijoʃtʃo] 'lamb+DIM'

(81)  AFFRICATE-FINAL STEMS + SUFFIX /-sale/:
    a. /gat<sup>s</sup>+sale/ → [gat<sup>s</sup>asale] / *[ga(s)sale] 'fond of salt'
    b. /leat<sup>s</sup>+sale/ → [leat<sup>s</sup>asale] / [lea(s)sale] 'fond of hake'

In derivational morphology, as with the prolative suffix /-t<sup>s</sup>at/, the use of the marker /a/ is also available with consonants other than stops and affricates, even though the form without epenthesis contains consonant sequences that are attested stem-internally. It is particularly relevant to compare stem-final /t<sup>s</sup>/ with /s/ (82). With the non-productive verbalizing suffix /-tu/, only one form – with or without /a/ – is acceptable in (82a-b), but it does not seem possible to predict which. With the productive suffix /-tʃo/, both forms are acceptable, with perhaps a slight preference for /a/-insertion.

(82)  STEMS ENDING IN OTHER CONSONANTS + DERIVATIONAL SUFFIXES:
    a. /eres+tu/ → *[eresatu] / [erestu] 'to get easy'
    b. /gris+tu/ → [grisatu] / *[gristu] 'to make grey'
    c. /lanbas+tʃo/ → [lambasatʃo] / (?)[lambastʃo] 'mop+DIM'
    d. /ames+tʃo/ → [amesatʃo] / (?)[amestʃo] 'dream+DIM'
    e. /tes+tʃo/ → [tesatʃo] / ?[testʃo] 'test+DIM'

Let us now summarize the results obtained for word-internal contexts. Stops and affricates can never surface before a consonant-initial suffix. A repair strategy must then be adopted. The use of /a/-final stems is the preferred option in general. Simplification is also available in derivation morphology but is slightly dispreferred. True epenthesis of /e/ seems to have become synchronically non-productive. Consonants other than stops and affricates are also disfavored in word-internal preconsonantal position, a situation that the use of the marker /a/ often prevents.

### 5.4.4.3. PW-final, IP-internal contexts

It is across word boundaries that we find the greatest amount of variation and number of possible strategies. Unlike stops in closed categories, those in nouns and adjectives never delete. Unlike stops and affricates preceding word-internal suffixes, both categories of segments can surface as such in preconsonantal position. But the

use of the form containing the marker /a/ is also generally possible, as well as affricate simplification, these two options being associated with faster speech and/or more colloquial registers. So we get two possibilities with stops, three with affricates, as illustrated in various syntactic contexts in (83) and (84).

(83)  STOPS IN PW-FINAL, IP-INTERNAL POSITION:
    a. /kokot bat/ → [kokot(a)bat]
       *neck one.ABS*
       'a/one neck'
    b. /iru kiʃket dakat/ → [kiʃketdakat] / [kiʃketarakat]
       *three lock.ABS.IND I-have*
       'I have three locks'
    c. /iru kiʃket bota dot/ → [irukiʃket(a)botarot]
       *three lock.ABS.IND throw.PERF AUX.1SGS.3SGD*
       'I have thrown three locks'

(84)  AFFRICATES IN PW-FINAL, IP-INTERNAL POSITION:
    a. /eskat<sup>s</sup> bat/ → [eskat<sup>s</sup>(a)bat] / [eskasbat]
       *kitchen one.ABS*
       'a/one kitcheń'
    b. /lau biʃot<sup>s</sup> meresi dot/ → [laubiʃot<sup>s</sup>(a)meresirot] / [laubiʃosmeresirot]
       *four heart.ABS.IND deserve.PERF AUX.1SGS.3SGD*
       'I have deserved three hearts'
    c. /iru lapit<sup>s</sup> topa dot/ → [irulapit<sup>s</sup>(a)toparot] / [irulapistoparot]
       *three pencil.ABS.IND find.PERF AUX.1SGS.3SGD*
       'I have found three pencils'

Fricative-final words can also marginally take the /a/-marker in indefinite contexts (85). This confirms the tendency that revealed itself in word-internal position for fricatives to be avoided in pre-consonantal position, although to a lesser degree than affricates.

(85)  FRICATIVES IN PW-FINAL, IP-INTERNAL POSITION:
    /frant<sup>s</sup>es bat/ → [frant<sup>s</sup>esbat] / ??[frant<sup>s</sup>esabat]
    *Frenchman one.ABS*
    'a/one Frenchman'

However, there is one context in which the choice of the /a/-final form of nouns is really marginal, that is before an adjective inside a noun phrase (86). Interestingly, this contextual restriction on the use of the /a/-form is not found in

Getxo, where the form with the marker /a/ in preadjectival position is more frequent than the one that uses simplification (87) (it seems that affricates cannot be kept intact in preconsonantal position in this dialect).

(86)    FINAL STOPS AND AFFRICATES IN DP-INTERNAL POSITION IN ONDARROA:
   a.    /kiʃket gori bat/        → [kiʃketgoribat] / ??[kiʃket<u>a</u>goribat]
         *lock red one.ABS.IND*
         'one/a red lock'
   b.    /eskat<sup>s</sup> balt<sup>s</sup>-a/        → [eskat<sup>s</sup>balt<sup>s</sup>a]/[eskasbalt<sup>s</sup>a]/ ??[eskat<sup>s</sup><u>a</u>balt<sup>s</sup>a]
         *kitchen black-ABS.SG*
         'the black kitchen'

(87)    FINAL STOPS AND AFFRICATES IN DP-INTERNAL POSITION IN GETXO:
         /iket<sup>s</sup> balt<sup>s</sup>-a/           →       [iket<sup>s</sup><u>a</u>balt<sup>s</sup>a] / [ikezβalt<sup>s</sup>a]
         *coal black-ABS.SG*
         'black coal'                                                    (from Hualde & Bilbao 1992)

In determining why /a/ is highly disfavored in noun+adjective sequences in Ondarroa, we have to consider the contexts where this marker appears in the DP. /a/ normally surfaces DP-finally, as it affects the interpretation of the whole noun phrase. The position of /a/ in (86) between the noun and the adjective does not conform to this rule, nor do all the instances of /a/ before the indefinite determiner /bat/ in (83a, 84a, 85) and those appearing between stems and case or derivational suffixes in section 5.4.4.2. But when we put aside the singular interpretation of /a/, which is what spearkers do when they use it in non-singular contexts for phonotactic purposes, another generalization on the placement of /a/ becomes available. /a/ only appears on the last noun or adjective in the DP. In other words, /a/ attaches to the last element in the DP that may bear it, which excludes DP-final elements that are not nouns or adjectives, e.g. /bat/ 'a/one', /bi/ 'two', and several case and derivational suffixes, like prolative /-t<sup>s</sup>at/ and diminutive /-tʃo/. This interpretation accounts for the distinction between (86a), where /a/ attaches to a non-final noun/adjective in the DP, and previous examples of /a/ followed by morphemes other than nouns or adjectives.

### 5.4.4.4. IP-final contexts

At the right edge of IPs and utterances, stops and affricates never delete nor simplify, as was the case for stops at the end of closed-category items. The choice of the form ending in /a/ is possible, but marginal and much less acceptable than in PW- and IP-internal contexts. This is shown in (88) at the right edge of dislocated constituents, i.e. at an IP boundary, and in (89) utterance-finally.

(88)    NO DELETION/SIMPLIFICATION OF STOPS AND AFFRICATES IP-FINALLY:
   a.    /lau kiʃket giʃon-ak eɾosi dau/ →  [laukiʃket]ᵢₚ giʃonakeɾosiɾau] /
                                                       ??[laukiʃket<u>a</u>]ᵢₚ giʃonakeɾosiɾau]
         *four lock.ABS.IND man-ERG.SG buy.PERF AUX.3SGS.3SGD*
         'Four locks, the man has bought'
   b.    /lau lapit<sup>s</sup> giʃon-ak eɾosi dau/ →  [laulapit<sup>s</sup>]ᵢₚ giʃonakeɾosiɾau] /
                                                       ??[laulapit<sup>s</sup><u>a</u>]ᵢₚ giʃonakeɾosiɾau]
         *four pencil.ABS.IND man-ERG.SG buy.PERF AUX.3SGS.3SGD*
         'Four pencils, the man has bought'

(89)    NO DELETION/SIMPLIFICATION OF STOPS AND AFFRICATES U-FINALLY:
   a.    /lau silbot/              →       [lausilbot] / ?? [lausilbot<u>a</u>]
         *four prominent belly.ABS.IND*
         'four prominent bellies'
   b.    /lau kiʃket/              →       [laukiʃket] / ??[laukiʃket<u>a</u>]
         *four lock.ABS.IND*
         'four locks'
   c.    /lau tʃikot/              →       [lautʃikot] / ??[lautʃikot<u>a</u>]
         *four rope.ABS.IND*
         'four ropes'
   d.    /bost okot<sup>s</sup>/            →       [bostokot<sup>s</sup>] / ??[bostokot<sup>s</sup><u>a</u>]
         *five chin.ABS.IND*
         'five chins'
   e.    /pijo bat beakat<sup>s</sup>/       →       [pijobabeakat<sup>s</sup>] / ??[pijobabeakat<sup>s</sup><u>a</u>]
         *pile one garlic.ABS.IND*
         'a lot of garlic'
   f.    /lau gorput<sup>s</sup>/           →       [laugorput<sup>s</sup>] / ??[laugorput<sup>s</sup><u>a</u>]
         *four body.ABS.IND*
         'four bodies'

### 5.4.5. SUMMARY

The table below summarizes the relevant facts about the behavior of final stops and affricates in both nominal and adjectival stems and closed-category items. The table tells whether stops and affricates are tolerated in non-prevocalic position in PW-internal, IP-internal, and IP-final position, and whether each of the possible

repair strategies – stop deletion, affricate simplification, and /a/-epenthesis[22] – is attested, and to what extent. The second half of the table provides the same information about morpheme-final consonants other than stops and affricates, notably fricatives.

(90)  SUMMARY OF THE BEHAVIOR OF MORPHEME-FINAL CONSONANTS:

| | PW-internal | IP-internal (PW- or PP-final) | IP-final |
|---|---|---|---|
| **Stops and affricates** Stops/affricates allowed? | **no** | **yes** | **yes** |
| Repair strategy? | **obligatory** | **optional** | **marginal** |
|    Stop deletion | N/A | yes | no |
|    Affricate simplification | ?yes | yes | no |
|    /a/-epenthesis | yes | yes | ??yes |
| **Other consonants (fricatives)** Other consonants allowed? | **yes** | **yes** | |
| Repair strategy? | **optional** | **marginal** | |
|    /a/-epenthesis | yes | (??yes/no) | |
|    Deletion | no | no | |

The higher they appear in the prosodic hierarchy, the more easily stops and affricates – and to a lesser extent other consonants – are licensed, from PW-internal to IP-final contexts.[23] First, these segments are disallowed in PW-internal position in non-prevocalic position, but tolerated PW- and phrase-finally. There are three possible strategies to prevent stops and affricates from surfacing in non-prevocalic position: the use of the /a/-final form, deletion (for stops), and simplification (for affricates). Stop deletion is impossible in all contexts with nominal and adjectival stems, but it is easily available for closed categories. The two remaining processes are available PW- and IP-internally, and only /a/-epenthesis is marginally allowed IP-finally. So fewer and fewer repair strategies are used as we go up the prosodic hierarchy, leaving more room for stops, affricates, and other consonants to surface.

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[22]I disregard "true" epenthesis, as it seems to be deprived of real synchronic productivity in the data under consideration. This omission has no significant effect on the subsequent analysis.
[23]I do not know whether /a/-epenthesis is an option at all with IP-final consonants other than stops and affricates, that is whether it is marginal, as with stops and affricates in (88)-(89), or clearly impossible. Without clear evidence, I will disregard this detail. Note that if the latter alternative holds, we should add DEP-/a/ >> C]$_\emptyset$→V to the rankings in (94), to exclude IP-final /a/-insertion with consonants other than stops/affricates.

**5.4.6. ANALYSIS OF EDGE EFFECTS IN ONDARROA BASQUE**

I present in this section a formal analysis of edge effects in Ondarroa Basque. The backbone of the analysis consists in a series of markedness constraints against stops and other consonants not followed by a vowel. The inherent ranking of the constraints, given in (91), reflects the role of the strength of the adjacent prosodic boundary and the greater vulnerability of stops, compared to other consonants.[24]

(91)  MARKEDNESS CONSTRAINTS AND THEIR INHERENT RANKING:
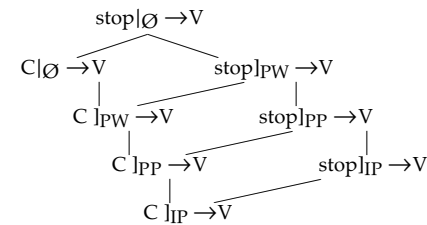


What has to be determined is how these constraints interact with the various faithfulness constraints that deal with the available repair strategies. This interaction yields a significant amount of variation, which manifests itself in the existence of several options or possible outputs for many inputs.

The faithfulness constraints I will be using are listed in (92). The constraint in (92a) deals with the deletion of postvocalic consonants. This constraint is violated in cases of stop deletion (observed only in closed-category lexical items). The constraint in (92b) penalizes affricate simplification, which I assume results in the deletion of an underlying [-continuant] feature. True vowel epenthesis violates the constraint in (92c); this constraint is high-ranked in Ondarroa Basque.

I suppose that the use of the /a/-final form of nouns and adjectives in contexts where it is not expected violates DEP-/a/ (92di), which could be viewed as an interpretative constraint that requires that the morpheme /a/ be associated with a singular meaning. A possible rule for the placement of /a/ has also been suggested: it normally appears on the last noun or adjective in the DP. This accounts for why /a/ is highly disfavored between nouns and adjectives in Ondarroa (86a).

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[24]The constraints specific to stops in (91) crucially apply to affricates in Basque. This contrasts with the Hungarian pattern, described in section 1.2.3.1 and partly analyzed in section 4.2.4, in which affricates behave like fricatives rather than like stops. This ambivalence of affricates is not unexpected given their dual nature: like fricatives they include frication noise; like stops they have crucial information concentrated in the release. I will not try to solve this ambiguity here.

The constraint in (92dii) penalizes the use of /a/ in contexts that do not conform to this rule. Notice that /a/-epenthesis is not at all an option with words other than nouns/adjectives since /a/ is a nominal morpheme. Epenthesis in closed-category items is concerned with the general DEP-V constraint; the constraints over /a/-epenthesis in (92d) are not even relevant in this case.[25]

(92)   RELEVANT FAITHFULNESS CONSTRAINTS:
   a. Constraint against deletion:
      MAX-C/V___          Do not delete a postvocalic consonant.
   b. Constraint against the simplification of affricates:
      MAX-[cont]          Do not delete a feature [continuant].
   c. Constraint against epenthesis:
      DEP-V               Do not insert a vowel.
   d. Constraints against /a/ insertion:
      i. DEP-/a/   Do not insert a proxy singular marker /a/ in nouns and
                   adjectives (i.e. in contexts where the marker does not have
                   the expected interpretation).
      ii. /a/=FINAL   /a/ attaches to the last element (noun or adjective) that
                      may bear it inside the DP.

We now have all the necessary elements for the final stage of the analysis of stops and affricates - and consonants more generally - in Ondarroa Basque. The list of outputs that our grammar has to generate is given in (93), together with the constraints that each of them violates. I use the words /eskat**s**/ 'kitchen', /kokot/ 'neck', and /lanbas/ 'mop' as examples of nouns/adjectives, and /semat/ 'how much, how many' as an example of a closed-category lexical item.

(93)   <u>Input</u>            <u>Output</u>                      <u>Constraints violated</u>
*PW-internally:*
a. /eskat**s**+tʃo/   →   [eskat**s**atʃo] 'kitchen-dim'      DEP-/a/
                      →   ?[eskastʃo]                        C]$_\emptyset$→V, MAX-[cont]
b. /kokot+tʃo/        →   [kokotatʃo] 'neck-dim'             DEP-/a/
c. /lanbas+tʃo/       →   [lambastʃo] 'mop-dim'             C]$_\emptyset$→V
                      →   [lambasatʃo]                       DEP-/a/

*PW-finally:*
d. /eskat**s** bat/   →   [eskat**s**bat]   'a kitchen'       stop]$_{PW}$→V
                      →   [eskat**s**abat]                    DEP-/a/
                      →   [eskasbat]                          C]$_{PW}$→V, MAX-[cont]
e. /kokot bat/        →   [kokotbat]      'a neck'           stop]$_{PW}$→V
                      →   [kokotabat]                         DEP-/a/
f. /lanbas bat/       →   [lambasbat]     'a mop'            C]$_{PW}$→V
                      →   ??[lambasabat]                      DEP-/a/
g. /eskat**s** gori/  →   [eskat**s**gori] 'red kitchen'      stop]$_{PW}$→V
                      →   [eskasgori]                         C]$_{PW}$→V, MAX-[cont]
                      →   ??[eskat**s**agori]                 DEP-/a/, /a/=FINAL
h. /kokot gori/       →   [kokotgori]     'red neck'         stop]$_{PW}$→V
                      →   ??[kokotagori]                      DEP-/a/, /a/=FINAL
i. /semat mutil/      →   [sematmutil]    'how many boys'    stop]$_{PW}$→V
                      →   [semamutil]                         MAX-C/___V

*IP-finally:*
j. /lau eskat**s**/   →   [laueskat**s**]  'four kitchens'    stop]$_{IP}$→V
                      →   ??[laueskat**s**a]                  DEP-/a/
k. /lau kokot/        →   [laukokot]      'four necks'       stop]$_{IP}$→V
                      →   ??[laukokota]                       DEP-/a/
l. /semat/            →   [semat]         'how many'         stop]$_{IP}$→V

Two constraints are never violated: stop]$_\emptyset$→V (since stops and affricates are banned from word-internal preconsonantal positions) and DEP-V (since true epenthesis is not used). I assume that constraints are undominated, unless there is evidence to the contrary. This assumption is justified for learnability reasons (Tranel 1995, 1996; Tesar & Smolensky 2000), but also has the virtue of simplifying the presentation. There cannot be evidence for unviolated constraints that they are dominated, so stop]$_\emptyset$→V and DEP-V will be considered undominated.

The only language-specific rankings (apart from the undominatedness of stop]$_\emptyset$→V and DEP-V) that need to be established in order to derive the data presented in the previous sections and summarized in (93) are given in (94), together with the empirical motivation for each ranking. We obtain the partial grammar in (95), in which dark and light lines indicate language-specific and inherent (universal) rankings, respectively. I have merged the constraints stop]$_{PW}$→V and stop]$_{PP}$→V and C]$_{PW}$→V and C]$_{PP}$→V into the constraints stop ]$_{PW/PP}$→V and C ]$_{PW/PP}$→V, since no distinction between the PW and PP levels is made in the data.

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[25]To prevent /a/-epenthesis with words other than nouns/adjectives we could have an undominated morphological constraint prohibiting the use of nominal suffixes with non-nominal morphemes. I will leave such a constraint aside here to avoid unnecessary complications.

(94)    RANKINGS SPECIFIC TO ONDARROA BASQUE:
        a. Consonants other than stops never delete:
           ⇒ MAX-C/V__ >> C ]Ø →V
        b. Affricate simplification is ruled out IP-finally:
           ⇒ MAX-[cont] >> stop ]IP →V
        c. Stop deletion is ruled out IP-finally:
           ⇒ MAX-C/V__ >> stop ]IP →V
        d. /a/-epenthesis is used instead of deletion with final stops in nouns:
           ⇒ MAX-C/V__ >> DEP-/a/

(95)    PARTIAL GRAMMAR OF ONDARROA BASQUE:

Undominated:            stop ]Ø ->V        DEP-V

                                    MAX-C/V__

MAX-[cont]      stop ]PW/PP ->V
                                        DEP-/a/      /a/=final

                            C ]Ø ->V

        stop ]IP ->V    C ]PW/PP ->V

                    C ]IP ->V
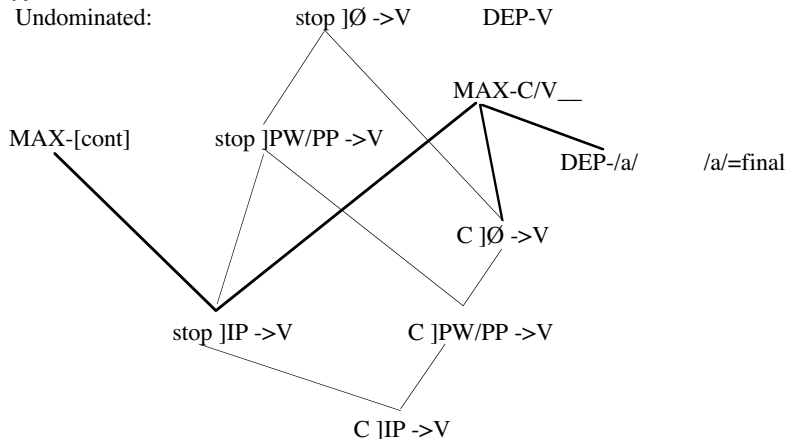
This mini-grammar generates all the outputs in (93). The large number of indeterminate rankings that remain among the constraints in (95) yields all the observed variation in the data. This is illustrated in the tableaux below for closed-category items IP-internally (96) and IP-finally (97), and for nouns/adjectives PW-internally (98), PW-finally (99), and IP-finally (100). Examples from (93) will be used.

In the discussion of this constraint system, two separate issues arise. First, does the grammar in (95) generate all and only the attested outputs in (93), irrespective of their relative well-formedness? Second, does it also yield the observed preferences or gradient well-formedness judgments among different possible forms, for example the fact that [eskat$^s$at͡ʃo], with /a/-insertion, is prefered over ?[eskast͡ʃo], with affricate simplification, in (93a)? The answer to the first question is yes; this is already a very welcome conclusion. The second issue is more difficult, but the results also clearly go in the expected direction. First, the data are subtle and establishing clear preference hierarchies is not straightforward. Second, analyzing

preferences involves calculating the proportion of total orders compatible with the grammar that generate each of the possible outputs. In the case of [eskat$^s$at͡ʃo] vs. ?[eskast͡ʃo], we expect that the former will be generated by a significantly greater number of total rankings than the latter. One problem here is that it is not clear what counts as relevant total orders in each particular case of variation. For example, when comparing [eskat$^s$at͡ʃo] vs. ?[eskast͡ʃo] and the number of rankings that generate each of them, do we consider the entire grammar, or should we disregard constraints and rankings that are irrelevant to this particular piece of data, e.g. constraints concerned with vowel quality, or those dealing with IP-final consonants? In other words, how local are the computations?

Such decisions may affect significantly the proportions obtained. For example, suppose that variation between two forms 1 and 2 results from ranking indeterminacy between two constraints A and B; 1 violates A and 2 violates B, so 1 wins if B dominates A and 2 wins if A dominates B. If we consider only these two constraints, forms 1 and 2 are predicted to be equally likely, since the probabilities that A outranks B and B outranks A are both 0.5. But suppose an additional constraint C, not relevant for the evaluation of the forms at hand. C is unranked with respect to A but strictly dominates B. There are three possible total rankings of these constraints: C>>B>>A, C>>A>>B, and A>>C>>B. B dominates A in one of these rankings, A dominates B in two of them. This creates an asymmetry in the likelihood of occurrence of 1 and 2, since the latter form is predicted to surface with a probability of 2/3, against only 1/3 for form 1. This shows that the relative well-formedness or frequency of competing forms generated by the grammar depends on what constraints and rankings are considered relevant in the computation.

In the absence of clear guidelines on these issues, the following discussion is highly exploratory. No strong claims are being made, but interesting indications do emerge. First, computations performed over strictly local portions of the grammar, which involve only the relevant constraints and rankings, generally yield the desired results, that is the expected proportions of total rankings generating each of the possible outputs.[26] Second, only in one situation do constraints not strictly relevant to the example at hand seem to play a crucial role in the evaluation of candidates. When dealing with constraints of the type C]$_i$→V, the corresponding higher-ranked constraints C]$_j$→V, where j is lower in the prosodic hierarchy than i, crucially intervene in the computation. Interestingly, the constraints C]$_k$→V, where k is

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[26]Although this will not be demonstrated here, the inclusion of additional constraints and rankings, e.g. all those in (95), results in proportions of total rankings generating a possible output that do not as closely match the expected ones. That is, the well-formedness judgments in (93) are better predicted by strictly local portions of the grammar than by more global ones.

higher in the prosodic hierarchy than i, play no role. In other words, it seems that when evaluating the well-formedness of a certain segmental configuration at a certain prosodic boundary, an implicit comparison is made with the same configuration at lower boundaries, which serve as a reference point. This situation arises in (99c) and (100) and will be further discussed below.

In going over the data in (93), let us first consider the situation for closed-category items, which is rather simple. The constraint against consonant deletion (MAX-C/V__) and that banning PW-final stops and affricates (stop]$_{PW}$→V) are unranked with respect to each other, which yields optional stop deletion IP-internally, as illustrated in (96). Other repair strategies like vowel epenthesis violate higher-ranked constraints and are unavailable. The two outputs in (96) are predicted to be equally well-formed since there are only two possible rankings of the relevant constraints. IP-finally, as illustrated in (97), only the faithful output is generated since stop]$_{IP}$→V is dominated by the relevant faithfulness constraints, which rule out epenthesis or deletion to prevent the appearance of IP-final stops.

(96)     IP-INTERNAL STOPS IN CLOSED-CATEGORY ITEMS:

| /sema**t** mutil/ 'how many boys' | DEP-V | stop]$_{PW}$ → V | MAX-C/V__ |
|---|---|---|---|
| → sema**t**mutil | | (t) | |
| → semamutil | | | * |
|   sema**t**<u>V</u>mutil | * ! | | |

(97)     IP-FINAL STOPS IN CLOSED-CATEGORY ITEMS:

| /ʃema**t**/ 'how many' | DEP-V | MAX-C/V__ | stop]$_{IP}$ → V |
|---|---|---|---|
| → ʃema**t** | | | (t) |
|   ʃema | | * ! | |
|   ʃema**t**<u>V</u> | * ! | | |

The situation in nouns and adjectives is much more complex since more constraints are involved and more variation is attested. Dealing first with word-internal contexts (98), the constraint stop]$_{\varnothing}$→V is undominated and unviolated, which bans any morpheme-final stop or affricate followed by a consonant-initial suffix, in particular the faithful outputs in (98a-b). "Pure" vowel epenthesis, indicated by an underlined <u>V</u>, is also ruled out by the undominatedness of DEP-V. The available repair strategies are /a/-insertion (which violates DEP-/a/) and affricate simplification (which violates MAX-[cont]); the ranking MAX-C/V__ >> DEP-/a/ eliminates consonant deletion as a possible repair for morpheme-final stops.

(98)     PW-INTERNAL STOPS, AFFRICATES, AND FRICATIVES IN NOUNS/ADJECTIVES:

| | DEP-V | stop]$_{\varnothing}$→V | MAX-C/V__ | C]$_{\varnothing}$→V | DEP-/a/ | MAX-[cont] |
|---|---|---|---|---|---|---|
| a. /eskat**ˢ**+tʃo/ 'kitchen+DIM' | | | | | | |
|   eskat**ˢ**tʃo | | (tˢ) ! | | * | | |
| → eskat**ˢ**<u>a</u>tʃo | | | | | * | |
| → ?eskastʃo | | | | * | | * |
|   eskat**ˢ**<u>V</u>tʃo | * ! | | | | | |
| b. /kokot+tʃo/ 'neck+DIM' | | | | | | |
|   kokottʃo | | (t) ! | | * | | |
| → kokot<u>a</u>tʃo | | | | | * | |
|   kokotʃo | | | * ! | | | |
|   kokot<u>V</u>tʃo | * ! | | | | | |
| c. /lanbas+tʃo/ 'mop+DIM' | | | | | | |
| → lambastʃo | | | | * | | |
| → lambas<u>a</u>tʃo | | | | | * | |
|   lambatʃo | | | * ! | | | |
|   lambas<u>V</u>tʃo | * ! | | | | | |

Starting with (98b), only the candidate with /a/-insertion survives in this case, the relevant competitors being straightforwardly eliminated by the highest three constraints in the tableau. In (98c), [lambastʃo] and [lambasatʃo] fare equally well, which follows from the undetermined ranking between DEP-/a/ and C]$_{\varnothing}$→V; [lambastʃo] wins out if DEP-/a/ >> C]$_{\varnothing}$→V, [lambasatʃo] wins with the opposite ranking of these two constraints, both rankings having the same probability.[27] The example in (98a) is slightly more complex. Two outputs are also attested, [eskat**ˢ**<u>a</u>tʃo] and ?[eskastʃo], but with a preference for the first one. The candidate with affricate simplification violates two constraints: MAX-[cont] and C]$_{\varnothing}$→V, whereas /a/-insertion results in only one violation of DEP-/a/. Taking these three constraints to be unranked, ?[eskastʃo] only wins if DEP-/a/ dominates both C]$_{\varnothing}$→V and MAX-[cont], whereas the preferred [eskat**ˢ**<u>a</u>tʃo] survives if either C]$_{\varnothing}$→V or MAX-[cont] is the highest-ranked of the three. Only 1/3 of the rankings generate ?[eskastʃo], against 2/3 for [eskat**ˢ**<u>a</u>tʃo], which accounts for the observed contrast in well-formedness and likelihood between these two forms.

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[27]Notice here the irrelevance of a lower-ranked constraint such as C]$_{PW}$→V, which is also unranked with respect to DEP-a; had we included it in the computation, [lambas<u>a</u>tʃo] would be predicted to be more likely or better formed, which does not appear to be the case.

The greatest amount of variation is observed PW- and PP-finally, as shown in (99). In this tableau not all the constraints are relevant to all the examples; to enhance its readability I have put in black for each example the constraints that can be disregarded. The constraint /a/=FINAL is irrelevant in (99a-c) since we are dealing with nouns that are the last ones in their DP. MAX-[cont] only plays a role in forms involving affricates (99a, 99d).[28] The constraint stop]PW→V can be disregarded in (99c), which only has a fricative in the relevant position. This example rather involves the markedness constraints C]Ø→V and C]PW→V, which are irrelevant to all the other forms containing stops and affricates, since it is the higher-ranked stop]PW→V that takes care of them.

(99)    PW-FINAL STOPS, AFFRICATES, AND FRICATIVES IN NOUNS/ADJECTIVES:

| | MAX-C/V__ | DEP-/a/ | MAX-[cont] | /a/=final | stop]PW→V | C]Ø→V | C]PW→V |
|---|---|---|---|---|---|---|---|
| a. /eskatˢ bat/ 'a kitchen' | | | | | | | |
| → eskatˢbat | | | | | (tˢ) | | * |
| → eskatˢabat | | * | | | | | |
| → eskasbat | | | * | | | | |
| b. /kokot bat/ 'a neck' | | | | | | | |
| → kokotbat | | | | | (t) | | * |
| → kokotabat | | * | | | | | |
| kokobat | * ! | | | | | | |
| c. /lanbas bat/ 'a mop' | | | | | | | |
| →lambasbat | | | | | | | * |
| →??lambasabat | | * | | | | | |
| lambabat | * ! | | | | | | |
| d. /eskatˢ gori/ 'red kitchen' | | | | | | | |
| →eskatˢgori | | | | | (tˢ) | | * |
| →??eskatˢagori | | * | | * | | | |
| → eskasgori | | | * | | | | * |
| e. /kokot gori/ 'red neck' | | | | | | | |
| →kokotgori | | | | | (t) | | * |
| →??kokotagori | | * | | * | | | |
| kokogori | * ! | | | | | | |

In (99a) each of the three possible outputs violates one constraint among DEP-/a/, MAX-[cont], and stop]PW→V. Considering again the ranking between these constraints to be free, the system generates these three outputs with equal probability, which is consistent with the observed well-formedness judgments. A similar situation holds in (99b): [kokotbat] violates stop]PW→V, [kokotabat] violates DEP-/a/. Both constraints are unranked with respect to each other, which results in the two outputs being equivalent in likelihood. The forms in (99c-e) also involve multiple possible outputs, but one of them is clearly disprefered over the other(s). Let us see how the rankings predict this. In (99c), the faithful and preferred output [lambasbat] violates C]PW→V, while the marginal output ?[lambasabat] violates DEP-/a/. These constraints are crucially unranked, which could be interpreted as predicting the two candidates to be equally likely, which is not the case. Here is where the higher-ranked constraint C]Ø→V, which is also unranked with respect to DEP-/a/, crucially intervenes. There are three possible rankings of the three constraints C]Ø→V, C]PW→V, and DEP-/a/: DEP-/a/>>C]Ø→V>>C]PW→V, C]Ø→V>>DEP-/a/>>C]PW→V, C]Ø→V>>C]PW→V>>DEP-/a/. The candidate [lambasbat] is optimal in the first two rankings, while [lambasabat] only wins in the third one. These distinct proportions account for the observed contrast in well-formedness between the two possible outputs. The cases in (99d) and (99e) are similar to (98a): three and four constraints, respectively, are involved in the variation observed. All of them are ranked freely with respect to each other, but in both examples the candidate with /a/-epenthesis violates two of these constraints (DEP-/a/ and /a/-FINAL), whereas the other possible outputs violate only one constraint (stop]PW→V or MAX-[cont]). As a result, the candidates with /a/-epenthesis are less likely to emerge as optimal as the alternative candidates.[29]

The final forms to be analyzed are the IP-final ones, as shown in (100). Stop deletion and affricate simplification being eliminated by the higher-ranked constraints MAX-C/V__ and MAX-[cont], the variation between the faithful outputs and the ones with /a/-epenthesis is accounted for as in (99c) above. Dep-/a/ is unranked with respect to both stop]IP→V and the higher-ranked stop]PW→V. Free ranking among these constraints leads to /a/-epenthesis being disfavored, as the corresponding candidates are generated by only one third of the possible rankings. In evaluating the well-formedness of ??[laueskatˢa] and ??[laukokota] at IP boundaries, an implicit comparison is made with the same forms at PW/PP boundaries, where consonants are less easily tolerated in non-prevocalic position.

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[28]MAX-[cont] is presumably also violated in cases of stop or fricative deletion, but such forms are taken care of by the constraint MAX-C/V__, so I make the simplifying assumption that MAX-[cont] plays no role in the computation of forms involving consonants other than affricates.

[29]In (99d) there are 24 possible rankings of the four relevant constraints; 4 of them select ??[eskatˢagori], again 10 each for [eskatˢgori] and [eskasgori]. In (99e) there are 6 possible rankings of the three relevant constraints; 4 of them select [kokotgori], against 2 for ??[kokotagori].

(100) IP-FINAL STOPS AND AFFRICATES IN NOUNS / ADJECTIVES:

| a. /lau eskat**ˢ**/ 'four kitchens' | MAX-C/V__ | MAX-[cont] | DEP-/a/ | stop]ₚW→V | stop]ᵢₚ→V |
|---|---|---|---|---|---|
| → laueskat**ˢ** | | | | | (tˢ) |
| → ?? laueskat**ˢ**a̲ | | | * | | |
|   eska**s** | | * ! | | | |
| b. /lau kokot/ 'four necks' | | | | | |
| → laukokot | | | | | (t) |
| → ?? laukokota̲ | | | * | | |
|   koko | * ! | | | | |

Before we move on to the next section, I would like to comment on certain aspects of this grammar, which concern the phonetic characteristics of stops in Ondarroa Basque, morpheme-internal stop-liquid sequences, and the ranking of DEP-/a/ and /a/=FINAL in other dialects.

First, I believe that the perceptual approach adopted here may receive some support from the phonetic characteristics of stops in IP-internal and IP-final position in Ondarroa Basque. IP-internal stops are consistently unreleased or reduced to a glottal articulation, whereas IP-final ones are quite systematically strongly released. The strength of the release burst is clearly associated with the lengthening and strengthening effects associated with domain-final positions, which are at the basis of the proposal developed in this thesis.

Second, it is worth mentioning that the ranking given above wrongly predicts the simplification of complex onsets in stem-internal position, e.g. in *proklama* 'proclaim' (see also note 26 in chapter 1). Other constraints are then necessary to distinguish between stem-internal consonant sequences and those created across word or morpheme boundaries. The former are never simplified, whereas morpheme-final stops do delete before liquids (/r, l/), even when the stop+liquid sequence forms a permissible morpheme-internal sequence, e.g. [kl] in (62a) and [kr, tr] in (63). I suggest that stem/root-medial consonants, such as /k/ in *proklama*, are saved by a STEM-CONTIGUITY constraint. Stem/root-initial ones (/p/ in the same example) could fall under the scope of specific root-initial faithfulness constraints (Beckman 1998), which are motivated by the psycholinguistic prominence of root-initial position. We could also define faithfulness constraints that distinguish between consonants that are followed by some segment in the same morpheme and consonants that are not (i.e. final consonants).

Finally, it has been noted that the Ondarroa dialect contrasts with Getxo, on the one hand, and Lekeitio, on the other hand, with respect to the use of /a/-final forms. The Getxo dialect is more advanced than Ondarroa in the reinterpretation of the marker /a/, which has almost completely lost its original meaning. As a consequence, /a/-forms are used more often and in more contexts than in Ondarroa. This presumably correlates with a lower ranking of DEP-/a/ and /a/=FINAL. In Lekeitio, by contrast, the marker /a/ has fully retained its function, and is never used in contexts where the singular form is not appropriate. In this dialect, DEP-/a/ and /a/=FINAL are therefore undominated.

**5.4.7. CROSS-DIALECTAL COMPARISONS AND THE OCP APPROACH**

The stop deletion and affricate simplification process in Basque has been amply discussed in the literature, especially in relation to the featural structure of affricates (see e.g. Hualde 1987, 1988, 1991; Lombardi 1990; van de Weijer 1992; H. Kim 1997; Fukazawa 1999). According to the standard description given in these works, the deletion/simplification process is triggered by a following [-continuant] consonant, but blocked in case a fricative follows. The process is viewed as an OCP effect on the [continuant] tier; it suppresses sequences of [-continuant] consonants by deleting stops and removing the [-continuant] part of affricates (which are assumed to be both [-continuant] and [+continuant]).

This is obviously not the account developed here, and I would like to comment on why I believe the OCP approach to be wrong. First, given an OCP constraint on [-continuant], it is not clear in this account why only stops, and not other [-continuant] consonants (nasals and possibly laterals; see note 30) are not subject to deletion before another [-continuant] feature. Second, the OCP approach is not supported by a crossdialectal comparison of stop deletion in Basque. The OCP analysis is largely based on the dialect spoken in Baztan (although this is not always explicitly mentioned). There is, however, a great deal of dialectal variation in various aspects of this phenomenon, and the data provided in many other dialectal descriptions, including Ondarroa presented above, are incompatible with the OCP. As we will see below, the evidence for the OCP in Baztan itself is not compelling, and may be reinterpreted in light of what is observed in other varieties.

The study of a number of other Basque dialects supports our idea that the driving force in the behavior of stops and affricates is that these consonants want to be followed by a vowel. Pre-consonantal stop deletion and affricate simplification should not be analyzed in an isolated way, as they appear to be part of a more general process of avoidance of non-prevocalic stops and affricates, in which the

OCP is not involved. First, deletion and simplification are not sensitive to the continuancy value of the following segment (except partly in Baztan; see 5.4.7.3), which is evidence against the OCP. Second, alongside deletion and simplification other strategies are used to prevent the prohibited or dispreferred configurations from surfacing, namely epenthesis and, as shown below, coalescence. Third, the pre-consonantal context, central in the OCP account, is not empirically adequate since pre-pausal stops and affricates also participate in the process. In Ondarroa, /a/-epenthesis is marginal pre-pausally (while other repairs are unavailable in that position), but a completely productive process of vowel epenthesis IP-finally is found in Arratia (5.4.7.1).

Below I review the stop deletion patterns observed in several varieties of Basque, other than Ondarroa. Only closed-category items will be discussed, as authors generally do not consider nominal and adjectival stems. The list of Basque dialects I will be using, together with the references where the data are taken from, is given in (101). This list is short and does not do justice to the extreme dialectal diversity found in Basque. But even this limited set shows enough variation for the analyst to get a reasonably good understanding of the processes involving stops and affricates in the language.

(101)  a. Biscayan:
           i. Northern Biscayan:
              • Lekeitio (Hulade, Elordieta & Elordieta 1994)
           ii. Southern Biscayan:
              • Arratia (Etxebarria Ayesta 1991)
           iii. Western Biscayan:
              • Getxo (Hualde & Bilbao 1992)
        b. Baztan (Salaburu 1984; H. Kim 1997; N'Diaye 1970)
        c. Souletin (Hualde 1993)

In all the dialects I have looked at, final stops (in closed-category items) clearly delete when followed in the same phrase by words beginning in a stop, an affricate, a nasal, and a lateral, as in Ondarroa above (58)-(60), (62). These consonants correspond to the set of [-continuant] segments[30], and deletion is expected under both the OCP and my approach. No examples involving [-continuant] consonants will be provided in this section. Let us now look at the other, [+continuant], consonants that can follow the stop: fricatives and rhotics. Here dialects differ and

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[30]The status of liquids with respect to continuancy has been disputed, but Hualde (1991) provides independent evidence that laterals are [-continuant] in Basque (see also van de Weijer (1995) and Kaisse (1998) for arguments for laterals being [-continuant]).

we find gaps in the data. Rhotics do not occur word-initially in the native Basque vocabulary. They appear in this position only in recent borrowings, older ones showing prothesis of /e/ or /i/ before /r/. As a consequence, most authors do not give examples of stops before /r/-initial words, which deprives us of one crucial piece of evidence for the OCP account. As for fricatives, different patterns are described, which do not generally support the OCP.

### 5.4.7.1. Biscayan dialects

In the Biscayan dialects stops delete before all consonants, without any noticeable contrast based on continuancy (or any other feature). As in Ondarroa, stop deletion before /r/- as well as fricative-initial words is clearly observed in Lekeitio and Getxo, as shown in (102)-(103).[31] For Arratia, Etxebarria-Ayesta (1991) does not provide examples of stops before /r/, but deletion before fricatives is well attested (104).[32]

(102)  STOP DELETION BEFORE FRICATIVES AND RHOTICS IN LEKEITIO:
        a. <lagúna**k** _f_eúuk dira>        /k f/ →    [f]    'the friends are ugly'
        b. <ni**k** _s_okia daukat>          /k s/ →    [s]    'I have the rope'
        c. <séma**t** _j_eneral>             /t x/ →    [x]    'how many generals'
        d. <gi_ʃ_óna**k** _j_enižodúnak dira> /k x/ →  [x]    'the men are grumpy'
        e. <séma**t** _rr_adížo>             /t r/ →    [r]    'how many radios'
        f. <Jone**k** _rr_adižúa dauko>      /k r/ →    [r]    'Jon has the radio'
                                             (Hualde, Elordieta & Elordieta 1994: 29-30)

(103)  STOP DELETION BEFORE FRICATIVES AND RHOTICS IN GETXO:
        a. /ba**t** falta da/        →    [báfaltaðá]       'one is missing'
        b. /ni**k** fíɾukes/         →    [nifíɾukés]       'I (erg.) with thread'
        c. /ikus do**t** ʃitánu/     →    [ikuzðóʃitánu]    '(I) have seen the gypsy'
        d. /entsun do**t** rádion/   →    [entsundoráðion]  'I heard it on the radio'
                                             (Hualde & Bilbao 1992: 18-19)

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[31]As is the case in Ondarroa, Hualde, Elordieta & Elordieta (1994) and Hualde & Bilbao (1992) note for Lekeitio and Getxo that deletion is not obligatory. This optionality is not marked in the examples but should be kept in mind.

[32]I give complete phonological and phonetic representations of the examples whenever possible, using the traditional slashes and square brackets. But many descriptions of Basque dialects transcribe data using the Basque orthographic conventions, and do not always provide all the necessary phonological and phonetic details of the dialect under study for me to give complete representations. In this case, I put the orthographic representations in angled brackets, and provide phonological and phonetic forms only for the relevant part of the example, which is underlined in the orthographic form.

(104)  STOP DELETION BEFORE FRICATIVES IN ARRATIA:
   a.  <jan do<u>t s</u>agara>            /t s/  →    [s]
   b.  <nik badauka<u>t x</u>axarea/      /t ʃ/  →    [ʃ]
   c.  <es do<u>k f</u>alta>              /k f/  →    [f]
   d.  <posi<u>k s</u>atos>               /k s/  →    [s]
                                        (Etxebarria Ayesta 1991: 262-268)

Arratia also displays an interesting process of IP- and utterance-final epenthesis. To save IP- or utterance-final stops, the last vowel is simply copied after the stop, as in (105).[33]

(105)  IP-FINAL EPENTHESIS IN ARRATIA:
   a.  /gu-**k**/              →    [gu**k**(u)]
       *we-ERG*
   b.  /ni-**k**/              →    [ni**k**(i)]
       *I-ERG*
   c.  /gison-a**k**/          →    [gisona**k**(a)]
       *man-ABS.PL or ERG*

**5.4.7.2. Souletin**

In Souletin, stops behave differently from those in Biscayan dialects before fricatives. Hualde (1993) reports that stops do not delete before a sibilant fricative (nothing is said about non-sibilant ones). Rather, the sequence becomes an affricate with the point of articulation of the fricative, as shown with /k/+fricative sequences in (106).

(106)  STOP-FRICATIVE COALESCENCE IN SOULETIN:
   a.  <húa<u>k z</u>ápha>       /k ɕ/  →    [tɕ]      'compress those'
   b.  <húa<u>k s</u>áa>         /k s/  →    [tˢ]      'weed those'
   c.  <húa<u>k x</u>áħa>        /k ʃ/  →    [tʃ]      'wash those'
                                          (Hualde 1993; from Larrasquet 1928)

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[33]I assume that IP-final epenthesis in Arratia follows from DEP-V being unranked with respect to stop]IP→V (while MAX-C/V▁ dominates both of them). But why can't epenthesis also apply IP-medially? I suggest that a contiguity constraint over the IP domain prevents IP-internal epenthesis, but has no effect at the right edge of IPs. This constraint has to rule out IP-medial epenthesis, but allow stop deletion. This is exactly what O-CONTIG (McCarthy & Prince 1995) accomplishes. This constraint is formulated in (i). (I-CONTIG would do the reverse, banning deletion but allowing epenthesis).
(i)    O-CONTIG (IP)       Segments that are contiguous in the input must be contiguous in the
                          output in the IP domain (no epenthesis within IP).

Coalescence of the two segments into an affricate has, just like deletion, the effect of removing the stop from its pre-consonantal position, with minimal changes in feature composition. If we consider affricates to be both [+continuant] and [-continuant], the resulting affricate retains all the features of the fricative, and all those of /t/. Only /k/ loses its place feature in the process. We can therefore see coalescence as a different means of avoiding pre-consonantal or non-prevocalic stops, on a par with deletion and epenthesis. The difference between this dialect and the Biscayan ones for stop+fricative sequences does not lie in the motivation of the process, but in the repair strategy adopted.

Stops merge with following fricatives but not with following stops, nasals, and liquids. Merging, however, would not be inconceivable as the complex segments that could result from the coalescence of stops with these categories are also attested: geminate stops, doubly articulated stops (e.g. labio-velar stops), post-nasal stops, and laterally-released stops. The fact that only stop-fricative coalescence is attested is certainly related to the fact that affricates are the only complex segments allowed in Basque, an effect akin to Structure Preservation.

**5.4.7.3. Baztan**

We are now left with the Baztan dialect. The Souletin and Biscayan patterns just described shed light on the Baztan one, which is why I postponed its description. In this dialect, stops do not delete before a sibilant fricative. I cannot tell from the references on Baztan how stops behave before non-sibilant fricatives, i.e. /f/ and /x/. Notice that /x/ is extremely marginal in this dialect (Salaburu 1984; N'Diaye 1970), and /f/ generally rare in Basque. The data in (107) illustrate the retention of /k/ before a sibilant fricative.

(107)  STOP RETENTION BEFORE FRICATIVES IN BAZTAN:
   a.  <ederra<u>k z</u>ineten>     /k ɕ/  →    [kɕ]   'you-PL. were beautiful'
   b.  <andrea<u>k s</u>artu dire>  /k s/  →    [ks]
                                                       (Salaburu 1984)

This single fact has motivated the claim that deletion occurs only before [-continuant] consonants, i.e. stops, affricates, nasals, and laterals, and that the deletion process, which removes a [-continuant] specification, follows from the OCP. But the dialects just reviewed suggest a different interpretation of the facts, and additional data in Baztan itself raise doubts concerning the validity of the OCP approach for this variety.

First, notice that examples with /r/-intial words in Baztan are absent from the sources, which deprives us of a crucial test for the account based on an OCP-[continuant] constraint. Second, in the case of word-final /t/ followed by a fricative, there is no doubt in Baztan that we get the corresponding affricate (Hualde p.c.), just as in Souletin (108). Now, why are both the stop and the fricative retained in the case of /k/ (107)? There is no deletion, as in Biscayan, nor do we get an affricate, as in Souletin. But this is only the general case. In the specific context of pronoun+finite verb constructions, /k/+fricative sequences turn into affricates with the point of articulation of the fricative, just as in /t/+fricative sequences (109). Pronoun+finite verb constructions thus contrast with e.g. noun/adjective+finite verb ones, as in (107a), and noun+non-finite verb, as in (107b).

(108)   /t/-FRICATIVE COALESCENCE IN BAZTAN:
        <eztaki_t_ _zer_ erran>        /t ɕ/   →      [tɕ]     'I don't know what to say'
                                                                        (N'Diaye 1970)

(109)   /k/-FRICATIVE COALESCENCE IN BAZTAN IN PRONOUN+FINITE VERB:
        a.   <hune_k_ _z_uen>          /k ɕ/ →       [tɕ]     'this one had it'
        b.   <he_k_ _z_iren>           /k ɕ/ →       [tɕ]
                                                                        (Salaburu 1984)

There are reasons to believe that the coalescence process illustrated in (109) used to be more general in Baztan. The examples in (107) represent the present state of affairs. But N'Diaye (1970), who uses the same example (107a), gives a different output, one with the affricate:

(110)   /k/-FRICATIVE COALESCENCE IN BAZTAN:
        <ederra_k_ _z_ineten>         /k ɕ/ →       [tɕ]
                                                                        (N'Diaye 1970)

Hualde (p.c.) remarks that "N'Diaye's informants belonged to an older generation, and it could very well be the case that at that point in time the [coalescence] rule had a wider domain of application in Baztan". This hypothesis seems natural in view of the Souletin pattern and the generality of the affrication process with word-final /t/ in Baztan itself. It is further supported by the fact that the coalescence of a non-coronal stop with a following sibilant fricative is well attested in this area in general. It also exists in Gascon and manifests itself in the adaptation of borrowings in the Northern Basque dialects, e.g. *etsenplu* 'example', *atsolutu* 'absolute'.

The hypothesis, then, is that Baztan was like Souletin at an earlier stage of the language. It has later undergone a change, which restricted affrication with /k/ and a following fricative to specific morpho-syntactic contexts. The difference between /t/ and /k/ with respect to the affrication process is obviously related to the fact that /k/, but not /t/, loses its place of articulation in the process. We can think that this change is linked to the promotion of a MAX-Place constraint. Looking at the present situation in Baztan, the specific behavior of /k/ before sibilants results from a localized change in the grammar, but there is no indication that the pattern has been reanalyzed as an OCP-based one (in particular in view of the fact that affrication is still attested in /k/+fricative sequences in some contexts). This being said, a synchronic analysis of Baztan raises a couple of issues, which I leave open. First, after affrication ceased to be productive with /k/+sibilant, why did not /k/ simply delete, as it does before other consonants? Second, how should we account for the contemporary situation in which the application of affrication depends on the precise morpho-syntactic context?

### 5.5. CONCLUSIONS

In this chapter I have proposed a new approach to edge effects, which refer to the greater tolerance for consonants and consonant combinations at edges of prosodic constituents as opposed to domain-internal contexts. Edge effects arise in particular through the asymmetrical behavior of phonological processes such as consonant deletion, vowel epenthesis, and vowel deletion. The standard approach to edge effects relies on the concept of extrasyllabicity, whereby edge consonants escape syllable well-formedness conditions. In the present account, edge effects rather follow from the increased perceptibility of segments in domain-initial and -final position, in comparison to domain-internal ones. This perceptually privileged situation arises through cue enhancement processes observed at edges: lengthening, articulatory strengthening, and diminution of overlap between adjacent segments. This perceptual approach eliminates the need for exceptional mechanisms such as extrasyllabicity.

From an empirical point of view, I have focused on edge effects above the word level, which have received little attention in the literature in comparison with those observed at the word level. Several patterns displaying cumulative edge effects, which increase as we go up the prosodic hierarchy, have also been described. The gradient or cumulative nature of edge effects follows naturally from the cue-based approach and is straightforwardly accounted for with the constraint system developed in chapter 3. A particularly interesting example of cumulative edge effects

is found in Ondarroa Basque, to which the second half of the chapter is devoted. This language displays stop deletion, affricate simplification, and epenthesis processes that serve to prevent morpheme-final stops and affricates, and to a lesser extent other consonants as well, from appearing in non-prevocalic position. These processes apply with decreasing likelihood as the boundary following the consonant becomes stronger. The analysis of this pattern has revealed interesting interactions between epenthesis and the opacity of some aspects of the nominal inflectional system, illustrating the use of vocalic morphemes for purely phonotactic purposes. This detailed description of the Ondarroa variety sheds new light on the already well-known process of stop deletion and affricate simplification in Basque, and provides evidence against the traditional OCP-based account of it.

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