Eulàlia Bonet* and Maria-Rosa Lloret

Fricative–affricate alternations in Catalan

https://doi.org/10.1515/probus-2018-0002

Abstract: Catalan has a [ʒ] ~ [tʃ] alternation that has traditionally been viewed as the consequence of final affrication of an underlying /ʒ/, a fortition operation, followed by general devoicing of obstruents. This interpretation has been held in classical generative rule-based approaches and also in autosegmental models, amounting either to a highly specific process or, when an attempt is made to generalize it, to wrong predictions; these shortcomings are also applicable to optimality-theoretic analyses. Following ideas in (Wheeler, Max W. 2005. The phonology of Catalan. Oxford: Oxford University Press), we propose that underlying affricates are subject to intervocalic lenition triggered by independently motivated general constraints. Sequences of a stop followed by a fricative can become affricates but cannot be affected by lenition. The interaction between affricates and gemination is also discussed.

Keywords: affricate, fortition, fricative, lenition, Catalan

1 Introduction

Most phonological processes apply to natural classes of segments. For instance, word final or coda devoicing affects obstruents, place assimilation often affects coronal consonants, vowel harmony can have as triggers high vowels or round vowels, and so on. It is not so common to find cases in the literature where a given phonological process targets a single segment. In this article, we discuss one such case from Catalan, the so-called final /ʒ/ affrication, by which a word-final voiced palatal fricative becomes an affricate and is further devoiced. Final affrication followed by devoicing is the classical generative interpretation of the [ʒ] ~ [tʃ] alternation, and autosegmental models have taken the same approach of trying to link this phenomenon to others in order to make it less specific.
Using data largely from Central (Eastern) Catalan, the alternative view that we defend here is that the alternation can be considered the result of the interaction between general constraints if it is interpreted as the effect of intervocalic lenition, following insights by Wheeler (2005); this alternative view puts the burden on underlying representations rather than on the operations involved.

The paper is organized as follows: in Section 2, we describe the distribution of sibilant fricatives and affricates in Catalan. Section 3 focuses on the accounts based on final affrication, starting with the classical generative rule-based account, and following with the autosegmental accounts in Mascaró (1984, 1986b), extended to gemination in affricates in Lloret (1992); we show that, in attempting to generalize the phenomenon, this line of analysis makes wrong predictions. Section 4 is devoted to the alternative view, namely that surface intervocalic [ʒ] is the result of the lenition of a voiced affricate /dʒ/. After a short summary of the historical origin of voiced affricates in Catalan in Section 4.1, in Section 4.2 we first review recent approaches within optimality theory (OT) by Wheeler (2005) and Torres-Tamarit (2016), which rely on the possibility of positing geminate affricates in the input. Our proposal excludes this possibility; we argue that all surface affricates, independent of their length, derive either from input single affricates or from sequences of stop and fricative, gemination being the result of syllable-related markedness constraints. In Section 4.3, we conclude.

## 2 Morphophonological alternations in sibilant fricatives and affricates

In most dialects of Catalan, the sibilant fricatives and affricates that can surface in intervocalic position are those shown in (1). There are two places of articulation, alveolar and palatal, and all the consonants can be either voiceless or voiced.

(1) Sibilant fricatives and affricates in the context V__V

<table>
<thead>
<tr>
<th></th>
<th>alveolar</th>
<th>palatal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>fricatives</strong></td>
<td>s</td>
<td>z</td>
</tr>
<tr>
<td><strong>affricates</strong></td>
<td>tʃ</td>
<td>dʒ</td>
</tr>
</tbody>
</table>

The examples in (2) illustrate each of the sounds. Not all sibilants are equally frequent, with intervocalic [tʃ] appearing only in a couple of native words, and
[dʒ] appearing in few words. Affricates are very rarely found in initial position, although palatal affricates often surface in this position and in postconsonantal position in some dialects (for some details see Section 4).

(2)  

<table>
<thead>
<tr>
<th>Word</th>
<th>Phonetic</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>caça</td>
<td>[kásə]</td>
<td>‘hunt’</td>
</tr>
<tr>
<td>casa</td>
<td>[kázə]</td>
<td>‘house’</td>
</tr>
<tr>
<td>eixut</td>
<td>[əʃút]</td>
<td>‘dry’</td>
</tr>
<tr>
<td>ajut</td>
<td>[əʒút]</td>
<td>‘help’</td>
</tr>
<tr>
<td>lletsó</td>
<td>[lətsó]</td>
<td>‘thistle, dandelion’</td>
</tr>
<tr>
<td>horitzó</td>
<td>[urídʒó]</td>
<td>‘horizon’</td>
</tr>
<tr>
<td>fletxa</td>
<td>[flétxa]</td>
<td>‘arrow’</td>
</tr>
<tr>
<td>lletja</td>
<td>[lədʒə]</td>
<td>‘ugly’</td>
</tr>
</tbody>
</table>

One aspect that we will ignore here but will be taken into consideration in Section 3.2.2 and Section 4 is the fact that intervocalic voiced affricates are pronounced as geminates, with only the stop lengthened (words like lletja and horitzó in (2) are actually pronounced [lədʒə] and [urídʒό], respectively); with voiceless affricates, gemination is instead variable and is mainly conditioned by stress. The number of contrasts that can be found in intervocalic position decreases in word-final position, with instances of neutralization. In (3), the relevant contexts involving alveolar consonants are shown, with pairs sharing the same morpheme. Such pairs are found with fricatives, (3a,b), but not with affricates in native words, (3c,d). The alveolar affricates that can be found in word-final position are generally heteromorphemic, the fricative portion belonging to the second person singular morpheme in verbs and the plural morpheme in other classes; homomorphemic alveolar affricates are found only in a few borrowings, like quibuts ‘kibbutz’ or hertz. The contrast between voiced and voiceless fricatives is lost in word-final position in favor of the voiceless variant due to word-final devoicing, (3b).

(3) Alveolar fricatives and affricates

| V_V | ||# # |
|-----|-----|-----|
| a.  | [s]~[s] | grassa [grásə]~gras [grás] | ‘fat.F/M’ |
| b.  | [z]~[s] | grisa [grízə]~gris [gris] | ‘gray.F/M’ |
| c.  | [ts]~—  | — | — |
| d.  | [dʒ]~—  | — | — |

With palatal sibilants, pairs can be found for all fricatives and affricates. As in (3), the contrast with respect to voicing that exists in intervocalic position is lost in final position, where only voiceless sibilants surface, (4b,d). In Catalan, final devoicing affects all obstruents, not only sibilants, and is an exceptionless

---

1 Geminate affricates can be represented in various ways. The reasons for opting for the transcription illustrated here with [dʒ] and [dʒ] will become apparent especially in Section 4.
phonological process. The case of special interest appears in (4b), exemplified with the pair \([b\check{o}\acute{\jmath}] ~ [b\check{o}\check{\jmath}]\). Here the palatal voiced fricative alternates with a palatal voiceless affricate, not a fricative, \(*[b\acute{\jmath}]\); in this type of example, final devoicing co-occurs with affrication.

(4) Palatal fricatives and affricates

\[
V_—V__V _##
\]

a. \([\acute{\jmath}] ~ [\acute{\jmath}]\) fluixa \([f\acute{\jmath}\acute{u}\check{o}]\) ~ fluix \([f\acute{\jmath}\acute{u}]\) ‘loose.F/M’
b. \([\acute{\jmath}] ~ [\acute{\jmath}]\) boja \([b\check{o}\acute{\jmath}\acute{\jmath}]\) ~ boig \([b\check{o}\check{\jmath}]\) ‘crazy.F/M’
c. \([\check{\jmath}] ~ [\check{\jmath}]\) gavatxa \([g\acute{\jmath}\acute{\jmath}\acute{a}\acute{t}\check{\jmath}]\) ~ gavatx \([g\acute{\jmath}\acute{\jmath}\acute{a}\check{\jmath}]\) ‘French.F/M (slang)’
d. \([\acute{d}\check{\jmath}] ~ [\acute{d}\check{\jmath}]\) lleig \([\acute{\jmath}\acute{e}\check{d}\check{\jmath}\acute{\jmath}]\) ~ lleig \([\acute{\jmath}\acute{e}\check{\jmath}]\) ‘ugly.F/M’

The alternation exemplified with the pair \([b\check{o}\acute{\jmath}] ~ [b\check{o}\check{\jmath}]\) is highly productive, and can be found both with roots and with suffixes, nouns, adjectives, or verbs. No examples can be found with a front high vowel \([i]\) preceding the sibilant; we will assume that this is due only to historical reasons. A few more examples are given in (5). For each pair, only one form with intervocalic \([3]\) is given, but this consonant is found in all the forms of the paradigm or in derivationally related forms, as long as it appears in intervocalic position.

(5) Examples with the \([3] ~ [\check{\jmath}]\) alternation

rajar \([r\acute{\jmath}\acute{a}]\) ‘to stream’ ~ raig \([r\acute{\jmath}\check{\jmath}]\) ‘stream’
fageda \([f\acute{\jmath}\acute{a}\acute{\jmath}\acute{a}]\) ‘beech forest’ ~ faig \([f\acute{\jmath}\acute{a}\check{\jmath}]\) ‘beech tree’
rogenc \([r\acute{\jmath}\acute{\jmath}\acute{e}\acute{\jmath}\acute{e\acute{\jmath}}}\) ‘reddish’ ~ roig \([r\acute{\jmath}\acute{\jmath}\check{\jmath}]\) ‘red’
blanquejar \([b\acute{\jmath}\acute{a}\check{\jmath}\acute{\jmath}\acute{a}]\) ‘to whiten’ ~ blanqueig \([b\acute{\jmath}\acute{a}\check{\jmath}\acute{\jmath}\check{\jmath}]\) ‘whitening’
assajos \([\acute{\jmath}\acute{a}\acute{\jmath}\acute{u}\acute{s}]\) ‘tests’ ~ assaig \([\acute{\jmath}\acute{a}\check{\jmath}]\) ‘test’
fugir \([f\acute{\jmath}\acute{\jmath}]\) ‘to run’ ~ fuig \([f\acute{\jmath}\check{\jmath}]\) ‘(s/he) runs away’
pujol \([p\acute{\jmath}\acute{u}\acute{\jmath}\acute{o}]\) ‘hill’ ~ puig \([p\acute{\jmath}\check{\jmath}]\) ‘mountain’

3 Analyses based on final affrication

3.1 The classical rule-based generative analysis

The fact that, as shown in (4), all four palatal sibilants contrast in intervocalic position, but three of them neutralize to \([\check{\jmath}]\) in word-final position led Lleó (1970) to conclude that the segments occurring in intervocalic position correspond to
the underlying forms and to posit a rule of final /ʒ/ affrication, a fortition-based analysis. The same analysis is assumed in later work, like Mascaró (1976), Wheeler (1979), or Bonet and Lloret (1998). The informal version of the rule that appears in (6) is the one given in Bonet and Lloret (1998: 107).

(6) Final /ʒ/ affrication: ʒ → dʒ/__ ##

The rule in (6) precedes final devoicing, in (7).

(7) Final obstruent devoicing: [–sonorant] → [–voice]/__##

If final devoicing preceded final /ʒ/ affrication, there would be no targets for affrication, because all /ʒ/ would become [ʃ] (e.g. /bɔʒ/ → *[bɔʃ]). If a more general process of affrication were posited, followed by final devoicing, a wrong output would be derived for underlying /ʃ/, as shown in (8) with the examples in (4a), boig [bɔtʃ] ‘crazy’M, and (4b), fluix [flúʃ] ‘loose’M.

(8) Wrong prediction with a general affrication rule

<table>
<thead>
<tr>
<th>Affrication</th>
<th>/bɔʒ/</th>
<th>/flúʃ/</th>
</tr>
</thead>
<tbody>
<tr>
<td>/dʒ/</td>
<td></td>
<td>/ʃ/</td>
</tr>
<tr>
<td>Devoicing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[bɔʃ]</td>
<td></td>
<td>*[flúʃ]</td>
</tr>
</tbody>
</table>

(vacuously)

Therefore, the conclusion is that the affrication rule must be specific to /ʒ/ and must precede the more general devoicing rule.

According to Mascaró (1986a), the domain of final /ʒ/ affrication is the word plus clitics, based on evidence from some dialects of Catalan. This domain corresponds to the clitic group in Nespor and Vogel (1986). In addition, the fact that, with enclitics, final affrication applies only when the enclitic starts with a consonant provides strong support for the idea that, within the clitic group, the target must be in coda position (compare fuig-hi [fú.ʒi] ‘run.away.2SG.IMP=there’ and fuig-ne [fúdʒ.nə] ‘run.away.2SG.IMP=from.it’). We will ignore domain-related issues in the rest of this paper, but the insight that affrication takes place in coda position is a key factor in the analyses offered in Section 3.2. An important shortcoming of this view is that an analysis based on fortition makes it a typologically rare phenomenon. Fortition is usually found in

2 Although in native words intervocalic [ʒ] alternates with word-final [ʃ], a few examples from loans can be found with intervocalic [ʒ] alternating with word-final [ʃ], as in beix [bɛʃ] ‘beige.SG’, [bɛʒus] ‘beige.PL’ in some dialects ([bɛʃus] in others). See also footnote 7.
prominent positions (like word-initial position or onset position) and not in weak positions (like word-finally or coda position). The same observation is noted by Wheeler (2005).

3.2 Trying to generalize final affrication in autosegmental phonology

3.2.1 Relating final affrication to other phenomena

Mascaró (1984, 1986b) aims to relate final affrication to other fortition phenomena found in Catalan in order to eliminate its *ad hoc* status. Mascaró (1984) analyzes spirantization of voiced stops in Basque, Catalan, and Spanish as spreading of the feature [continuant] from a preceding segment to a voiced non-sibilant obstruent unspecified for continuancy, which gives rise to the sounds [β], [ð], and [ɣ], all [+continuant]. But Catalan, unlike Basque or Spanish, does not allow voiced non-sibilant approximants in coda position. In a word like *cabré* [kə βɾe] ‘I will fit’, the approximant [β] surfaces because it is in onset position and is preceded by a [+continuant] segment, a vowel. But in the word *cabdell* [kə β.lɛ] ‘ball of yarn’, the same non-sibilant voiced obstruent is in coda position and spirantization is blocked. To account for this blocking, Mascaró (1984) proposes a rule that inserts the feature [−continuant] in coda position, as shown in (9), where R stands for ‘rhyme’.

\[
\text{(9) Rule of [−continuant] insertion (Mascaró 1984: (11))}
\]

\[
\begin{array}{c}
\text{[+voice]} \\
\text{[−son]} \\
\end{array} \rightarrow \quad \text{[−cont]} / \quad \text{R}
\]

The rule in (9) targets not only non-sibilant obstruents, but also /ʒ/. (10) reproduces the derivation of a sequence that contains both types of obstruent. (10a) contains the underlying [+continuant] value for the vowels and the sibilant fricative. In (10b), two instances of [−continuant] have been inserted in coda position, at the end of each monosyllabic word; one of them results in a voiced labial stop and the other one in a voiced palatal affricate. (10c) shows the spreading of the feature [−continuant] on the first word-final stop to the word-initial stop of the second word, an effect of the same rule that produces spirantization when the feature to be spread is [+continuant]. Finally, (10d)
illustrates final devoicing. The interpretation of affricates as a sequence of the values [−continuant] [+continuant] is the one assumed in the rest of the paper. (For alternative representations, see Lin 2011.)

(10) Derivation of the sequence *cap boig* [kabɔtʃ] ‘no madman’ (adapted from Mascaró 1984: (15))

```
a. +ct     +ct+ct         b. +ct−ct     +ct−ct+ct
[k à b]      b ʒ dʒ]     → [k à b]     b ʒ dʒ]
```

c. +ct−ct   +ct−ct+ct
[k à b] b ʒ dʒ] → [k à b] b ʒ dʒ]

d. +ct−ct   +ct−ct+ct
```

Mascaró’s (1984) rule of [−continuant] insertion has the advantage of generalizing final affrication to a strengthening process independently needed to account for the lack of spirantization in coda position. In addition, it accounts for the absence of affrication in underlyingly voiceless sibilants, thus avoiding outputs like *fluix* ([flúʃ]) *[flútʃ] ‘loose.M’ (see (8)). Moreover, lenition does not affect intervocalic affricates, like *lletja* [ʎéʤa] ‘ugly.r’ in (4d), because the spirantization rule is restricted to non-sibilant obstruents. However, as formulated, the stop insertion rule in (9) wrongly predicts that the feature [−continuant] should be inserted also when there is a final underlyingly voiced alveolar sibilant; words like *gris* (/ɡɾiz/) [ɡɾis] ‘gray.M’ should be pronounced *[ɡɾits]; hence, final affrication overapplies. This problem cannot be fixed by establishing that [−continuant] insertion applies after final devoicing, because then the insertion rule would affect all palatal sibilant consonants, not just /ʒ/. In addition, the place of articulation of the target of [−continuant] insertion cannot be restricted to palatals, because, for non-sibilants, the process must affect labials, coronals, and dorsals ([b], [d], [ɡ]). In conclusion, while relating final affrication and blocking of spirantization to a general strengthening process ([−continuant] insertion) would be desirable, the specificity of final affrication makes it inadequate.

Mascaró (1986b) retakes final affrication and the lack of spirantization of voiced non-sibilant consonants, the set of both phenomena now being renamed stop formation, and extends the view of coda fortition to other phenomena, which include r-tensing (a trill instead of a flap in words like *màrtirs* [már.tirs] ‘martyrs’ and *b, g* gemination, as in *possible* [pusib.blə] ‘possible’). He proposes the general rule of gemination reproduced in (11).
According to Mascaró (1986b), all the aforementioned phenomena can be accounted for with the gemination rule, together with the assumption that syllabification applies cyclically, and the idea that geminates cannot be altered and hence cannot be affected by spirantization (that is, [continuant]-spreading); the feature [–continuant] is inserted by default. The gemination rule applies massively to all consonants in coda position, but it is followed by degemination (cluster simplification) whenever one of the geminates cannot be syllabified (not in cases like [pusíb.bl] ‘possible’, where syllabification of the geminate is possible). With this proposal, he concludes that the [–continuant] insertion rule of Mascaró (1984) in (9) can be eliminated. This new proposal works well for all the phenomena it is intended to cover except for final affrication, as shown in (12), with the words gris ‘gray.M’ and boig ‘crazy.M’. Both /gréz/ in (12a) and /bɔʒ/ in (12b) undergo gemination of the last consonant because both /z/ and /ʒ/ are voiced and they are in coda position. Because the inserted C slot cannot be syllabified, it undergoes cluster simplification, which is followed by devoicing.

The derivation in (12) works well for gris, [gréz], but for boig it predicts the unattested form *[bɔʃ]. Final affrication underapplies; as a matter of fact, it cannot be derived. Again, trying to analyze final affrication as the result of a more general mechanism that affects different types of consonants in different ways is a priori a more desirable approach, but, as shown, it fails to cover final affrication.

3.2.2 Extending the gemination rule to affricates

In Section 2, we mentioned briefly that intervocally voiced affricates are systematically realized as geminates (e.g. lletja [ʎɛdʒə] ‘ugly.F’), while intervocalic voiceless affricates can vary in length often depending on the position of
stress (e.g. \textit{fletxa} [flɛtʃə] ~ [flɛtʃə] ‘arrow’). Lloret (1992) adopts the approach of Mascaró (1986b) to account for gemination of voiced affricates. The cyclic rule of gemination in (11) affects all voiced affricates in coda position. When these affricates are in intervocalic position they surface as geminate, but when they are in final position the inserted C cannot be syllabified and the affricate surfaces as short. The proposal appears illustrated with the derivation of the word \textit{jutge} [ʒúdʒə] ‘judge’ in (13) (corresponding to Lloret 1992: (13)) and the derivation of the word \textit{mig} [mítʃ] ‘half’ in (14) (from Lloret 1992: (14)). In (14b), the symbol © indicates a C-slot subject to deletion.

(13) a. \[ \begin{array}{c} \sigma \\ C \end{array} \] b. \[ \begin{array}{c} \sigma \\ C \end{array} \] c. \[ \begin{array}{c} \sigma \\ C \end{array} \]

In (13a), the root of the word \textit{jutge} /ʒúdʒə/ is syllabified, the inflectional ending /a/ being outside that domain.\footnote{It is worth pointing out that nothing in the analyses of Mascaró and Lloret hinges on the last vowel being interpreted as lexical or epenthetic, though we will return to this issue in Section 4.3.} In (13b), the next step of the derivation, when the inflectional ending is parsed syllabically it cannot incorporate the preceding affricate as an onset because, by assumption, /dʒ/ is disallowed intervocally. Since the affricate remains in coda position, the gemination rule in (11) applies and a new C slot is inserted associated with the affricate, as shown in (13c). In that situation, the first C of the affricate is syllabified as a coda, and the rest of the affricate, now postconsonantal, can be syllabified as the onset of the last syllable. In (14a), the root /mídʒ/ is syllabified and, being the only overt morpheme of the word, undergoes the gemination rule. But the inserted C cannot be syllabified and is subject to Stray Erasure, as indicated in (14b) with the notation ©. Final devoicing is the last step of the derivation, (14c). A crucial point of Lloret’s analysis is that she has to assume that the voiced palatal affricate cannot be syllabified intervocally in order for gemination to apply when -/a/ is inserted in the next cycle. However, when it comes to the rhotics,
she is obliged to assume, like Mascaró (1986b: 171), that /ɾ/ can never occur in syllable-initial position, so that the flap forces its resyllabification with a preceding stop before gemination can apply, as in pobre [póɾ.βɾə] ‘poor’ (vs. the geminated output in poble [póblə] ‘town’, where the lateral can syllabify with the next vowel and thus entail stop gemination at the stage of the derivation where the stop appears in syllable-final position: ‘póblə’). Again, then, trying to analyze the behavior of affricates as the result of a more general mechanism requires highly ad hoc assumptions for it to work.

In Section 3.3, we discuss approaches to final affrication within OT ignoring the intervocalic gemination of voiced affricates just addressed. This issue becomes relevant for the alternative view of the [ʒ] ~ [ʃ] alternation, namely as lenition in intervocalic position, the topic of Section 4.

### 3.3 Final affrication in optimality theory

In this section, we discuss final affrication within several models of OT, starting with a parallel version of the theory, and we reach the conclusion that the mapping of /ʒ/ into [ʃ] can only be derived through the use of ad hoc constraints.

The fact that there is general final devoicing can be attributed to the ranking of the markedness constraint NO-VOICED-CODA, in (15a), above the constraint that demands faithfulness to voicing, IDENT(voice) in (15b). And the fact that in final position there is an affricate instead of a fricative is a violation of a faithfulness constraint against changes in manner of articulation, which we will represent here as IDENT(cont).

(15) a. NO-VOICED-CODA: Assign one violation mark for every voiced obstruent in coda position.
    b. IDENT(voice): Assign one violation mark for correspondent segments that do not have identical values for the feature [voice].
    c. IDENT(cont): Assign one violation mark for correspondent segments that do not have identical values for the feature [continuant].

While the ranking NO-VOICED-CODA $\gg$ IDENT(voice) accounts for final devoicing of all obstruents, some constraint should force the selection of an affricate over a fricative at the end of the word, a fortition constraint.4 This fortition

---

4 As noted by Wheeler (2005), fortition is usually found in prominent positions, like initial position and postconsonantal position, not in final position, typically a weak position.
constraint cannot be general, because it should not affect alveolar sibilants, only palatals, since alveolar fricatives do not become affricates at the end of the word (recall examples like grisa [grízə] ~ gris [grís] ‘gray.F/M’, in (3b), where the alternation involves voicing, not manner). We will refer to this constraint as FORT(pal)##, which would be violated by non-affricate sibilant palatals in word-final position. The ranking FORT(pal)## ≫ IDENT(cont) ensures that a word like boig [bɔ̀tʃ] (/bɔ̀ʃ/) ‘crazy.M’ is realized with a final affricate, as shown in (16). In all the tableaux, a W indicates that the constraint being considered favors the winner (the optimal candidate), while an L indicates that for that constraint the losing candidate (loser) fares better than the optimal candidate (see McCarthy 2008).

(16) boig /bɔ̀ʃ/: [bɔ̀ʃ] ‘crazy.M’ (parallel version)

<table>
<thead>
<tr>
<th></th>
<th>/bɔ̀ʃ/</th>
<th>NOVCDCODA</th>
<th>FORT(pal)##</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☞ a.</td>
<td>bɔ́ʃ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b.</td>
<td>bɔ̀ʃ</td>
<td>*(!)W</td>
<td>*(!)W</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>c.</td>
<td>bɔ́ʃ</td>
<td>*!*W</td>
<td>*</td>
<td>*</td>
<td>L</td>
</tr>
</tbody>
</table>

However, the same ranking leads to overapplication of affrication of underlying voiceless palatal fricatives, as in fluix [flúʃ] (/flúʃ/) ‘loose.M’. This is shown in (17), where the intended winner loses.

(17) fluix /flúʃ/: *[flúʃ] ‘loose.M’ (parallel version)

<table>
<thead>
<tr>
<th></th>
<th>/flúʃ/</th>
<th>NOVCDCODA</th>
<th>FORT(pal)##</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☞ a.</td>
<td>flúʃ</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>☞ b.</td>
<td>flúʃf</td>
<td>L</td>
<td>*</td>
<td>W</td>
<td>*</td>
</tr>
</tbody>
</table>

The fact that, as argued for in Section 3.1, in rule-based approaches final affrication must precede final devoicing in a sort of counterbleeding relationship could lead to the conclusion that a serial version of OT, such as harmonic serialism (McCarthy 2010), might be more adequate to handle final affrication and devoicing, that is, through the derivation /ʒ/ → dʒ → [ʃ]. The derivation of boig is shown in (18) and (19). In the first step of the derivation, (18), the possible candidates include one with the voiced affricate, (18a), the faithful candidate, (18b), and a candidate with devoicing, (18c). A form with [ʃ] is not a possible candidate at this point because in harmonic serialism at each step GEN allows
only one change with respect to the input for each candidate, and \[\text{ʃ}\] differs from /ʒ/ in voicing and manner of articulation. The ranking of the relevant markedness constraints must be FORT(pal)## ≫ No-VOICED-CODA, with FORT (pal)## also being ranked above IDENT(cont).

(18) Step 1 for *boig* /bɔ́ʒ/: [bɔ́ʃ] ‘crazy.m’ (harmonic serialism)

<table>
<thead>
<tr>
<th>/bɔ́ʒ/</th>
<th>FORT(pal)##</th>
<th>NOVCDCODA</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bɔ́ʃ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. bɔ́ʒ</td>
<td>*!W</td>
<td>*</td>
<td>L</td>
<td>*</td>
</tr>
<tr>
<td>c. bɔ́ʃ</td>
<td>*!W</td>
<td>L</td>
<td>*W</td>
<td>L</td>
</tr>
</tbody>
</table>

In (19), step 2, the input is the winner of step 1, /bɔ́ʃ/. A candidate with [ʃ] is not possible because it differs from the input in voicing and manner of articulation. At step 3, convergence will be reached, because it is not possible to obtain a more harmonic form; so the winner of the derivation will be [bɔ́ʃ].

(19) Step 2 for *boig* /bɔ́ʒ/: [bɔ́ʃ] ‘crazy.m’ (harmonic serialism)

<table>
<thead>
<tr>
<th>/bɔ́ʃ/</th>
<th>FORT(pal)##</th>
<th>NOVCDCODA</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bɔ́ʃ</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. bɔ́ʃ</td>
<td>*!W</td>
<td>L</td>
<td>*W</td>
<td>L</td>
</tr>
<tr>
<td>c. bɔ́ʃ</td>
<td>*!W</td>
<td>L</td>
<td>*W</td>
<td>L</td>
</tr>
</tbody>
</table>

But due to the needed high ranking of FORT(pal)##, harmonic serialism also predicts affrication with underlying /ʃ/, as was the case with the parallel version of OT, illustrated in (17) with the word *fluix* [flúʃ] ‘loose.m’, for which a surface form *[flútʃ]* is predicted. A more specific constraint is needed to exclude final affrication in underlingly voiceless palatal fricatives; these segments must be faithful to their underlying representation; they cannot change. Let us call this constraint FATH(ʃ) provisionally, to see its effects.\(^5\) FATH(ʃ) must be ranked above FORT(pal)##. This constraint will be vacuously satisfied for the example in (18) and (19), but it is crucial for the derivation of final [ʃ], which must remain faithful to its input. This is illustrated in (20). Convergence is reached at step 1.

\(^5\) Instead of restricting the faithfulness constraint to the voiceless palatal fricative with FATH(ʃ), one could eliminate this constraint and restrict the fortition constraint to voiced palatals only (FORTITION(voiced palatal)##), with the same effects.
Step 1 for fluix /flúʃ/: [flúʃ] ‘loose.m’ (harmonic serialism)

<table>
<thead>
<tr>
<th>/flúʃ/</th>
<th>FAITH(ʃ)</th>
<th>FORT(pal)##</th>
<th>NOVCDCODA</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. flúʃ</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. flútʃ</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td></td>
<td>*W</td>
</tr>
<tr>
<td>c. flúʒ</td>
<td>*!W</td>
<td>*</td>
<td>*W</td>
<td>*W</td>
<td></td>
</tr>
</tbody>
</table>

As a matter of fact, once the need for a highly specific constraint like FAITH(ʃ) is acknowledged, the motivation for the intuitively adequate serial derivation is lost. The inclusion of the same constraint derives equally well all the forms in a parallel account. The tableau in (21) corresponds to (17) with the addition of this new constraint (for (16), the derivation of boig in a parallel model, FAITH(ʃ) is satisfied vacuously because the input does not contain a /ʃ/).  

(21) fluix /flúʃ/: [flúʃ] ‘loose.m’ (parallel version)

<table>
<thead>
<tr>
<th>/flúʃ/</th>
<th>NOVCDCODA</th>
<th>FAITH(ʃ)</th>
<th>FORT(pal)##</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. flúʃ</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. flútʃ</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td></td>
<td>*W</td>
</tr>
</tbody>
</table>

The set of relevant constraints can be simplified if the comparative markedness model of McCarthy (2003) is assumed, a possibility also discussed for final affrication in Torres-Tamarit (2016). Within this model, for any markedness constraint there are two variants: either the marked structure is not present in the faithful candidate, identical to the input (new violation), or the marked structure is also present in the faithful candidate (old violation). The relevant alternative constraint under this view would be N*ʃ, in (22), where the subscript N stands for ‘new’.

(22) N*ʃ: Assign one violation mark to any ʃ that is not present in the fully faithful candidate.

---

6 The constraint FAITH(ʃ), but not FORT(pal)##, could be eliminated if the OT model with candidate chains (OT-CC) is assumed (McCarthy 2007). In OT-CC, each candidate reproduces a potential derivation, a chain (with one change at a time, as in Harmonic Serialism), and a new kind of constraint (PRECEDENCE constraints) replicates the effects of extrinsic rule ordering by imposing the order in which phonological changes must take place within the chain. We do not develop this analysis here because, in addition to the high complexity of the model, it does not provide new insights into these order-governed changes.
In comparative markedness, the constraint $N^*ʃ$ would have a counterpart $O^*ʃ$ (where the subscript O stands for ‘old’), a constraint that would penalize $ʃ$ when present in the fully faithful candidate. With $N^*ʃ$, the constraint $\text{FORT(pal)}##$ becomes unnecessary and the desired results are obtained. The tableaux corresponding to boig and fluix appear in (23) and (24), respectively, with this new constraint set. In (23c), the candidate $[bɔʃ]$ contains a $ʃ$ that is not present in the fully faithful candidate $[bɔʒ]$ and hence constitutes a new violation of $*ʃ$. This situation contrasts with the candidate (24a) $[flúʃ]$, the faithful candidate. In this case $N^*ʃ$ is not violated, even though the candidate contains a $ʃ$, because this consonant is also present in the faithful candidate itself; it is therefore an old violation, not a new one. The affricate $[tʃ]$ for input $/ʒ/$ in (23) is the only possible output, because the underlying voiced consonant is disallowed in final position and the most obvious repair, a change in voicing, is disallowed by the constraint $N^*ʃ$. There is no need for a constraint explicitly forcing affrication. A more drastic change, the deletion of $/ʒ/$, would be ruled out by $\text{MAX}(\text{segment})$, a highly ranked constraint not included in the tableaux.

(23) **boig** /bɔʒ/: $[bɔʃ]$ ‘crazy.m’ (comparative markedness)

<table>
<thead>
<tr>
<th>$/bɔʒ/$</th>
<th>NOVCDCODA</th>
<th>$N^*ʃ$</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
<th>$O^*ʃ$</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $bɔʃ$</td>
<td>✔</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. $bɔʒ$</td>
<td></td>
<td>✔</td>
<td>L</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>c. $bɔʃ$</td>
<td></td>
<td>✔</td>
<td>*</td>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>

(24) **fluix** /flúʃ/: $[flúʃ]$ ‘loose.m’ (comparative markedness)

<table>
<thead>
<tr>
<th>$/flúʃ/$</th>
<th>NOVCDCODA</th>
<th>$N^*ʃ$</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
<th>$O^*ʃ$</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $flúʃ$</td>
<td>✔</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. $flúʃ$</td>
<td></td>
<td>✔</td>
<td>*!W</td>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>

This constraint ranking will yield the right results for all other fricatives and affricates. The tableau in (25) corresponds to an example with an underlying voiced alveolar fricative, gris /griz/ ‘gray.m’. The winning candidate, [grís], satisfies the markedness constraint NO-VOICED-CODA and the candidate with final affrication, (25c), is ruled out because it unnecessarily violates IDENT(cont).
(25) gris /gríz/: [grís] ‘gray.M’ (comparative markedness)

<table>
<thead>
<tr>
<th>/gríz/</th>
<th>NOVcCODA</th>
<th>IDENT(voice)</th>
<th>IDENT(cont)</th>
<th>o*ʃ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. grís</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. gríz</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. gríts</td>
<td></td>
<td>*</td>
<td>*!W</td>
<td></td>
</tr>
</tbody>
</table>

One concern is that the constraint $N^*ʃ$ is highly specific, and the same can be said for the handy constraint $\text{FAITH}(ʃ)$ in (20) and (21). It is not an easy task to formalize either constraint with features and exclude from the formalization the corresponding affricate. We assume, following the tradition started by Sagey (1986), also assumed in Mascaró (1984) and Lloret (1992), that the difference between fricatives and affricates is that the former have the feature [+continuant], while the latter have the feature [–continuant] in addition to [+continuant]. Hence, it is difficult to translate into the relevant features a constraint like $*ʃ$; in addition to the place of articulation features and [–voice], the feature [+continuant] should be mentioned to the exclusion of [–continuant].

So far, we have considered the $ʒ$ ~ $ʃ$ alternation as the result of affrication (and devoicing) on a final /ʒ/, and have shown that, in either rule-based models or models like OT, it requires highly specific rules or constraints. The attempts to view affrication as part of a more generalized fortition syndrome result in over-application or underapplication, leaving aside the fact that fortition in weak positions (like word-final position) are quite rare typologically.⁷

### 4 The alternative view: intervocalic lenition

#### 4.1 On the development of $[dʒ³]$  

Up to now, we have explored the possibility that we are dealing with a fortition process involving affrication of word-final /ʒ/. Though this approach holds from a synchronic view, from a diachronic perspective the process took place the other way around, i.e. $[dʒ³]$ underwent deaffrication intervocalically ([ʒ], as in

---

⁷ Alternations like beix [bɛʃ] ‘beige.sg’, [bɛʒus] ‘beige.pl’, mentioned in footnote 2, constitute a case of underapplication because final affrication fails to apply to /bɛʒ/. Under the alternative approach presented in Section 4.3, [bɛʃ] is simply the result of final devoicing.
RÜBEA > ro[ðʒ][a] > ro[ʒ][a] ‘red.F’) and devoicing word-finally (RÜBEU > ro[亹] ‘red.M’) (e.g. Badia 1981: 194, 213, 216; Veny and Massanell 2015: 275–276; Caro Reina 2016: 148–149; Recasens 2017: 210). In fact, in conservative dialects such as most Valencian varieties, though devoicing also applies word-finally (ro[亹]), the affricate [ðʒ] systematically appears intervocally (ro[ðʒ][a]), for which a single affricate phoneme /ðʒ/ and absence of /ʒ/ is the most likely interpretation (Jiménez 1999: 220; Wheeler 2005: 11). Hence, intervocalic deaffrication is a relatively recent innovation in the development of Catalan. The fact that in all dialects the affricate was retained in certain words (as in me[ðʒ]e ‘doctor.M’) derives from their different etymological origin. In Old Catalan, the reflexes of Vulgar Latin -BY-, -DY-, -GY-, and -J- underwent deaffrication (as seen in ro[ʒ][a]), while the reflexes of Vulgar Latin -D’C- and -T’C- were maintained as affricates (as in MED’CU > me[ðʒ]e). This distinction was systematically marked in the spelling of Old and Middle Catalan, with the former represented as <g, j> and the latter as <tg, tj>. As several scholars have pointed out, this implies that the two reflexes were pronounced differently. Some authors conclude that <g, j> involved the fricative [ʒ] pronunciation, while <tg, tj> involved the affricate [ðʒ] pronunciation (e.g. Miralles 1984: 135–136; Farreny 1986: 126–127; Rabella 1998: 167–169). Other scholars go further and suppose that the different spellings were indicative of a single affricate [ðʒ] pronunciation in the former case and a geminate affricate [ððʒ] pronunciation in the latter, with deaffrication applying later to single affricates only (Lamuela 1984, 1992; Caro Reina 2016: 266–267).

According to Caro Reina (2016: 278–279), evidence for the geminated pronunciation comes from word line division in fourteenth century texts (word division is indicated by blank spaces in the following examples):

Word division involving the affricates <tg> and <tz> suggests that the affricates are realized as geminates as in met ge (metge [médʒə] ‘doctor’) and met zinat (metzin-at [madʒinát] ‘poison. PTCP[M’]), respectively [as happens with other geminates (e.g. marabal lant, meravellant ‘marvelous’)]. Otherwise, word division would have resulted in *me tge and *me tzinat.

As happens with single consonants (e.g. ma rit, marit ‘husband) and falling sonority transitions (e.g. res ponie, responie ‘(s/he) answered’).

8 There has been some controversy regarding the historical development of these alternating sounds, which are reflexes of Vulgar Latin -BY-, -DY-, -GY-, and -J-. Some scholars have supported the view that the old development was [j], which first strengthened to a fricative [ʒ] and later to an affricate [ðʒ] (e.g. Coromines 1974); other scholars argue instead that the old development of [j] first strengthened to a palatal affricate [dʒ], which then intervocally became [ðʒ] and later turned into [ʒ] in some dialects, but devoiced to [ʃ] word-finally in all dialects (e.g. Badia I Margarit 1981: 194, 213, 216). The commonly accepted interpretation at present is the latter (see Recasens 2017: 207–212 for in-depth discussion of this issue).
From a typological point of view, patterns of deaffrication are also well attested in other languages, which are typically interpreted as spirantization processes, that is, as weakening effects in lenition-favoring contexts (Kirchner 1998). For example, Florentine Tuscan Italian shows spirantization of voiceless stops and /g/ in intervocalic position word-internally and across words, with an optional intervening liquid or glide (26a); in the same context, affricates become fricatives (26b) (Giannelli and Savoia 1978; Schafer 1995: 65; Lin 2011: 374; Kirchner 1998: 253–256). Along the same lines, in Kabardian ejective affricates spirantize and in Chitwan Tharu /dʒ/ becomes [z] in intervocalic position (Kirchner 1998: 304, 307).

(26) Standard Italian Florentine

a. [ˈkaːpo] [ˈkaːbo] ‘head’
   [ˈpjɛtɾa] [ˈpjɛθra] ‘stone’
   [ˈlakāsa] [ˈlaxāsa] ‘the house’
   [ˈsuːɡo] [ˈsuːuɡo] ‘sauce’

b. [ˈpafɛ] [ˈpafɛ] ‘peace’
   [eθʃɔ̞ɡa] [eθʃɔ̞xa] ‘and (s/he) plays’

Lin (2011: 373–375) also discusses a CVC prefixing reduplication process in Nisgha (a Tsimshianic language spoken in northwestern British Columbia) in which stops and fricatives in the root are fully copied (27a). When the second consonant is a velar or uvular stop, or a coronal or lateral affricate, it becomes a fricative (27b). According to Shaw (1987) and Lombardi (1990: 419–420), this change also implies a spirantization process, which does not apply to labials because there is no labial fricative in the phonemic inventory of the language and hence the process is blocked by structure preservation (Kiparsky 1985).

(27) a. [ˈqaːp] [ˈqap-qaːp] ‘piece’
   [ˈtʰux] [ˈtʰax-ʰux] ‘to throw something’

b. [tak] [tax-tak] ‘to forget’
   [loq] [lox-loq] ‘to get up early’
   [tʃaɾɬ] [tʃal-ʃaɬ] ‘record’
   [paɾs] [pis-paɾs] ‘to lift something’

In the following sections, we discuss two different interpretations of the present-day Catalan patterns from the alternative view of deaffrication as lenition, within the tenets of OT. In Section 4.2, we examine an analysis that follows the assumption that there are underlying single and geminate affricates (/dʒ/ and /dʒdʒ/). In Section 4.3, we present our analysis, based on the existence of a single affricate /dʒ/.
4.2 Starting from single and geminate affricates

Wheeler (2005: 15–22) discusses three possible interpretations for the relation between palatal fricatives and affricates: interpretation A consists of deriving all occurrences from a single affricate input; interpretation B consists of deriving them from a single fricative input; and interpretation C consists of deriving them from both affricate and fricative inputs with the addition of a segment unspecified for continuancy depending on the environment.

In Section 3.3, we presented the problems associated with deriving affricate occurrences from a single fricative, a possibility that Wheeler also dismisses. As for the other two interpretations, he concludes that interpretation C seems more plausible for the voiceless palatal affricates, with the coexistence of input contrasts involving /ʃ/ (e.g. fluix /flûj/) and /ʎ/ (e.g. gavatx /gəβátx/) ‘French.M (slang)’, gavatxa /gəβátxa:/ ‘French.F (slang)’), as well as neutralized contexts in non-postvocalic positions (e.g. xinēs [finēs] ‘Chinese.M’, panxa [pānxa] ‘belly’). He also assumes that there should be further inputs with biphonemic sequences of /tʃ/ to justify cases of word-final vowel epenthesis in words like cotxe /kɔtʃə:/ [kɔtʃa] ‘car’ (vs. gavatx [ɡəβátx]) due to the sonority increase towards the syllable edge between the two coda consonants (fricatives being more sonorant than stops); we will return to the issue of epenthesis in Section 4.3. Contrariwise, he considers interpretation A to be more plausible for the voiced counterparts, i.e. /dʒ/ inputs and absence of /ʒ/ inputs. In his account, though, interpretation A for all voiced palatal fricative and affricate occurrences entails input contrasts between single affricates (/dʒ/), leading to weakening not only in expected lenition-favoring contexts, such as intervocally (e.g. boja /bɔdʒə:/ [bɔdʒə] ‘crazy.F’ vs. boig /bɔdʒ/: [bɔdʒ] ‘crazy.M’), but also in typically fortition-favoring contexts, such as word-initially and postconsonantally (e.g. gel /dʒɛl/: [ʒɛl] ‘ice’, menja /mɛnʒə:/ [mɛnʒə] ‘(s/he) eats’), as the author himself admits (p. 16). Additionally, he is obliged to assume inputs with a geminate affricate /ddʒ/, leading to a geminate realization (e.g. metgessa /mɛdʒəsə:/ [mɛdʒəsə] ‘doctor.F’) and further word-final vowel epenthesis (e.g. metge /mɛdʒə:/ [mɛdʒə] ‘doctor.M’), as well as allomorphy (/ʃ/, /dʒ/) to justify the absence of word-final vowel epenthesis in words like lleig /ʎɛdʒ, ʎɛdʒ/: lleig /ʎɛdʒ/: [ʎɛdʒ] ‘ugly.M’ (vs. metge [mɛdʒə]), lletja /ʎɛdʒə:/ [ʎɛdʒə] ‘lletja.F’. In (28) and (29), we sum up Wheeler’s preferred interpretations with representative examples in each context.9

9 For the eastern dialects of Catalan under discussion, Wheeler (2005: 13–15) presents further surface variation encountered between fricative and affricate realizations in word-initial and postconsonantal positions. There are, in fact, three major patterns: (a) the standard pattern,
   a. Word-initially and postconsonantally: /X/ unspecified for continuancy
      Xinès / Xinɛz/: [jinɛs] ‘Chinese.M’
      Panxa / pǎnXə/: [pəŋʃə] ‘belly’
   b. Intervocalically: /ʃ/ and /tʃ/
      fluixa / flúʃa/: [fluʃa] ‘loose.F’
      gavatxa / gəβatʃə/: [gəβatʃə] ‘French.F (slang)’
   c. Word-finally: /ʃ/, /tʃ/, and the stop-plus-fricative sequence /tʃ/
      fluix / flúʃ/: [flúʃ] ‘loose.M’
      gavatx / gəβatʃ/: [gəβatʃ] ‘French.M (slang)’
      cotxe / kɔtʃ/: [kɔtʃə] ‘car’

(29) Voiced palatal sibilants: inputs /dʒ/, (absence of /ʒ/), /d̥dʒ/, and /dʒ, d̥dʒ/ allomorph (Wheeler 2005)
   a. Word-initially and postconsonantally: /dʒ/
      gel /dʒɛl/: [ʒɛl] ‘ice’
      menja /mɛndʒə/: [mɛnʒə] ‘(s/he) eats’
   b. Intervocalically: /dʒ/ and /d̥dʒ/
      boja / bɔdʒə/: [bɔdʒə] ‘crazy.F’
      metgessa /mɛdʒɛsə/: [mɛdʒɛsə] ‘doctor.F’
   c. Word-finally: /dʒ/ and /d̥dʒ/
      boig / bɔdʒ/: [bɔtʃ] ‘crazy.M’
      metge / mɛdʒə/: [mɛdʒə] ‘doctor.M’
   d. Allomorphy: /dʒ, d̥dʒ/
      lleig / ʎeʃ/: [ʎeʃ] ‘ugly.M’
      lleitja / ʎeʃə/: [ʎeʃə] ‘ugly.F’

illustrated in (28) and (29), which is the basis of our analysis and the common pronunciation in the northern part of eastern Catalan (in the Girona region); (b) the pattern in which all palatal fricatives are realized as affricates in the aforementioned contexts (xinès [ʃinɛs], panxa [pəŋʃə], gel [dʒɛl], menja [mɛnʒə]), which is the common realization in the southern part of eastern Catalan (in the Tarragona region); and (c) the pattern that prefers voiceless palatal affricates word-initially and postconsonantally (xinès [ʃinɛs], panxa [pəŋʃə]) while presenting an intrusive stop (with a shorter duration) for voiced palatal affricates in postconsonantal position, especially after a nasal or a lateral (menja [mɛnʃə]), which is the most common pronunciation in the Barcelona region. (Hualde et al. 2015 conducted a production experiment involving the latter pattern for voiced palatals and showed that there are different phonetic degrees of fortition that vary according to the contexts in which they occur.)
Nevertheless, Wheeler concludes that, within the tenets of OT, given

the logic of Lexicon Optimization and ‘Richness of the Base’ [...] all occurring allophones need an explicit account. Thus when \([\text{dʒ]}\) and \([\text{j}]\) alternate, the constraints need to be identified to favour the correct output whichever occurs in the input representation. And when \([\text{dʒ]}\) and \([\text{j}]\) are in contrast, the account ought not to depend on details of input representation, provided that the input contrast is ‘notated’ in some way that is reflected naturally in the output. (p. 22)

For that reason, he ends up interpreting surface affricates as biphonemic sequences of stop-plus-fricative (e.g. \(/\text{dʒ}/\), \(/\text{ʃf}/\)) and derives affrication and gemination from sonority requirements (we will make explicit the sonority requirements at work in Section 4.3). Nonetheless, he does not provide a formal analysis for the alternating fricative–affricate cases like \([\text{bʒə}~\text{bʒ}]\). He merely points out that although this kind of alternation has some aspects in common with stop spirantization, which he analyzes as an effect of Laziness in lenition-favoring contexts (“Lazy: Minimize articulatory effort”; Kirchner 1998: 38), it does not result from the same causes in the same conditions. He additionally emphasizes the idea that in cases with no categorical complementary distribution of two (or more) allophones (as is the case of fricative–affricate alternations), lexical representations are important (pp. 326–327).

Pursuing the idea of single and geminate affricate inputs, Torres-Tamarit (2016) suggests that while voiceless palatal affricates contrast in being fricative or affricate (/ʃ/ in, e.g. fluix, fluixa, and /tʃ/ in, e.g. gavatx, gavatxa), voiced palatal affricates contrast in being single or geminate affricates (/dʒ/ in, e.g. boig, boja, and /dʒdʒ/ in, e.g. lletja). In (30) and (31), we sum up the interpretation he proposes for each context. Torres-Tamarit does not discuss the surface coexistence of words with final palatal affricates and words presumably provoking word-final vowel epenthesis in the same context, i.e. cases (28d) (gavatx vs. cotxe) and (29c) and (29d) (lleig vs. metge) in Wheeler’s analysis. All we can infer from his work is that it might be considered that words like cotxe and metge have an underlying word-final vowel and thus follow the patterns in (30b) and (31b) for gavatxa and lletja, respectively (i.e. /kɔtʃa/, /mɛdʒə/).

(30) Voiceless palatal sibilants: inputs /ʃ/ and /tʃ/ (Torres-Tamarit 2016)

a. Word-initially and postconsonantally: /ʃ/ and /tʃ/
   xìnès /ʃinéz/: [ʃinə] ‘Chinese.M’
   Txec /tʃɛk/: [tʃɛk] ‘Czech.M’
   pànʃə /pánʃə/: [pánʃə] ‘belly’
b. Intervocally: /ʃ/ and /tʃ/

fluixa /floga/: [flʊɡa] ‘loose.F’
gavatxa /gɑbɑɪja/: [ɡɑbɑɪja] ‘French.F (slang)’

c. Word-finally: /ʃ/ and /tʃ/

fluix /flʊj/: [flʊ] ‘loose.M’
gavatx /gɑbɑ́tʃ/: [ɡɑbɑ́tʃ] ‘French.M (slang)’

(31) Voiced palatal sibilants: inputs /dʒ/ (absence of /ʒ/) and /dʒdʒ/ (Torres-Tamarit 2016)

a. Word-initially and postconsonantally: /dʒ/

gel /dʒɛl/: [ʒɛl] ‘ice’
menja /mɛndʒə/: [mɛndʒə] ‘(s/he) eats’

b. Intervocally: /dʒ/ and /dʒdʒ/

boja /bɔdʒə/: [bɔdzə] ‘crazy.F’
lletja /lɛdʒə/: [lɛddʒə] ‘ugly.F’
metgessa /mɛdʒɛsə/: [mɛddʒɛsə] ‘doctor.F’

c. Word-finally: /dʒ/ and /dʒdʒ/

boig /bɔdʒ/: [bɔtʃ] ‘crazy.M’

Torres-Tamarit models a tentative analysis within the bidirectional phonetics and phonology (BiPhon) model (Boersma 1998, 2009), which distinguishes multiple levels of representations. For our purposes, it is sufficient to differentiate the underlying form (represented between ‘|...|’), the phonological surface form, and the phonetic form. BiPhon allows a strict division between the phonological level and the phonetic level, with different constraints operating in each mapping: faithfulness constraints relate the underlying form with the phonological surface form; markedness constraints evaluate the phonological surface forms; cue constraints relate the phonological surface form with the phonetic form from the auditory point of view while articulatory constraints evaluate the articulatory phonetic form; and sensorimotor constraints relate the auditory form with the articulatory form (Boersma 2009). In Torres-Tamarit’s analysis, /dʒ/ is phonologically penalized by the markedness constraint */dʒ/ (on the basis of being a complex segment), which rules out all phonological occurrences of /dʒ/ in favor of /ʒ/ at the phonological level. Then, an articulatory phonetic constraint STRENGTHEN evaluates the degree of affrication that best suits each position (based on data by Hualde et al. 2015; see footnote 8), with intervocalic position being the context that most severely penalizes fortition (i.e. affrication). The maintenance of the affricate in words like lletja is attributed to its geminate underlying input [dʒdʒ], which blocks deaffrication at the
phonological level presumably due to the effect of geminate inalterability (e.g. |ʎedʒə|: /ʎedʒə/). Though he does not mention the case of lleig, one could presume either that in word-final position geminate affricates obligatorily simplify because of the impossibility of having geminates in codas (|ʎedʒə|: /ʎedʒə/; |ʎedʒə|: *|ʎedʒə|) or alternatively that there is allomorphy, in line with Wheeler’s proposal (|ʎedʒə|: /ʎedʒə/; |ʎedʒə|: /ʎedʒə/).

4.3 Starting from a single affricate /dʒ/  

So far, we have shown that all analyses face the problem of finding a matching solution for the voiceless and voiced sets ([bɔ́tʃ]~[bɔ́ʒə], [ʎédʒə]~[ʎédʒə]), as well as for cases that presumably entail word-final vowel epenthesis in the same contexts that others do not ([gəβə́tʃ]~[gəβə́ʒə]; [kɔ́tʃ]; [bɔ́tʃ], [ʎétʃ] vs. [mɛ́dʒə]).

Our approach starts from the assumption that geminate affricate realizations within words are best dealt with as derived, and not as a consequence of geminate inputs. As other scholars have noted (e.g. Wheeler 2005: 36–37), geminates are rather rare in Catalan, especially in the obstruent set. There are few examples with /dd/ and /bb/; the items mainly belong to learned vocabulary or are loanwords, which strongly tend to degeminate in the case of /dd/ (32a). There are no /gg/ cases (loanwords like nugget are pronounced [núɣet]). Nor are there geminate fricatives, since they have evolved into a degeminated realization (e.g. piscina [piśina] ‘swimming pool’, adolescent [əduləsɛn] ‘teenager’). Geminate sonorants are more common but also tend to degeminate, especially if they are not presumably derived from assimilation (32b). Contrariwise, as discussed in Section 3.2.1, there exists a gemination process that targets voiced stops /b/ and /g/ before /l/ in certain contexts (32c), but not affecting Valencian and some other western dialects. (In the examples presented in (32), the most common pronunciation is given first.)

(32) a. addicte [əðɨkta]~[əddɨkta] ‘addicted.M’  
adduir [ədduí]~[əðuí] ‘to adduce’  
obvi [bβbi] ‘obvious.M’  
futbol [fubbɔ́l] ‘soccer’  

b. tranquil·la [traŋkɪlə]~[traŋkɪllə] ‘quiet.F’  
atleta [əʎlɛ́tə] ‘athlete’  
espatlla [əspɒ́ʎʎə]~[əspɒ́ʎə] ‘shoulder’  
billet [biʎʎɛ́t]~[biʎɛ́t] ‘ticket’

(Example text continues.)
Regarding the issue of word-final vowel epenthesis, different scholars have pointed out that, while there is more conclusive evidence for internal epenthesis (see, e.g. Lloret 2002; Wheeler 2005: 252–257; Pons 2011) and word-initial epenthesis (see Lloret and Pons-Moll 2016), there is no morphophonological evidence for true word-final epenthesis in Catalan (see, e.g. Dols and Wheeler 1996; Wheeler 2005: 251–252). The evidence for word-final epenthesis is inconclusive, mainly because there are words ending in the nominal class marker -<e>e after well-formed codas (e.g. rude /rʊd-a/: [rʊdə] ‘rude-M’, pare /pá-r-a/: [páɾə] ‘father-M’, enorme /ənɔrm-a/: [ənɔrma] ‘huge-M’, which show class marker -a instead of the regular ‘zero’ class marker that masculine nominals typically have (e.g. fred /frɛd/: [frɛt] ‘cold-M’, car /kɑr/: [kɑr] ‘expensive-M’, ferm /fɛrm/: [fɛrm] ‘firm-M’). A more convincing argument for their non-epenthetic status, put forward by several scholars for Spanish (e.g. Harris 1987; Colina 2003; Bonet 2006) and that now we extend to Catalan, is that while word-initial epenthesis is systematic and applies to new borrowings (e.g. [e]striptease in Spanish, [ə]striptease in Catalan), word-final epenthesis is totally unproductive (e.g. single (applied to records and people) [sɪŋgel] in Spanish, [sɪŋgal] in Catalan vs. native words like ingl[e] ‘groin’ in Spanish, cingl[a] ‘cliff’ in Catalan). Since no evidence leads overwhelmingly to an epenthesis interpretation, we assume that all word-final vowels are lexical, and hence are present in the inputs.

The final observation to take into account is that the phonology of Catalan has nonetheless an affrication process (lexical and postlexical) that turns stop-plus-fricative sequences into affricates, in heteromorphemic contacts (e.g. gats [gɑts] ‘cats’ vs. gat [gɑt] ‘cat’) as well as across words (e.g. barret xinès [bɑrɛtʃinès] ‘Chinese hat’ vs. barret [bɑrɛt], Chinese [ʃinès]). Our starting point, thus, is that the unmarked situation is to regard all instances of surface affricates as deriving from stop-plus-fricative sequences through sonority-related constraints, except for the fricative-affricate alternations (i.e. the [bɔʒə] ~ [bɔʒə] cases), for which we propose a single affricate input /dʒ/, which turns into [ʒ].
through lenition intervocally.\(^\text{10}\) The examples in (33) and (34) illustrate the palatal sibilant distribution we assume for each context.

(33) Voiceless palatal sibilants: inputs /ʃ/ and the stop-plus-fricative sequence /tʃ/
  a. Word-initially and postconsonantally: /ʃ/ and the stop-plus-fricative sequence /tʃ/
     xinès /ʃinɛz/: [ʃinɛs] ‘Chinese.M’
     panxa /pænʃa/: [pænʃa] ‘belly’
     Txec /tʃek/: [tʃek] ‘Czech.M’
  b. Intervocally: /ʃ/ and the stop-plus-fricative sequence /tʃ/
     fluixa /fluʃa/: [fluʃa] ‘loose.F’
     gavatxa /gaβaʃa/: [gaβaʃa] ‘French.F (slang)’
  c. Word-finally: /ʃ/ and the stop-plus-fricative sequence /tʃ/
     fluix /fluʃ/: [fluʃ] ‘loose.M’
     gavatx /gaβatʃ/: [gaβatʃ] ‘French.M (slang)’
     cotxe /koʃa/: [koʃa] ‘car’

(34) Voiced palatal sibilants: inputs /ʒ/, /dʒ/, and the stop-plus-fricative sequence /dʒ/
  a. Word-initially and postconsonantally: /ʒ/
     gel /ʒɛl/: [ʒɛl] ‘ice’
     menja /mɛŋʒa/: [mɛŋʒa] ‘(s/he) eats’
  b. Intervocally: /dʒ/ and the stop-plus-fricative sequence /dʒ/
     boja /bɔdʒa/: [bɔdʒa] ‘crazy.F’
     lleťja /lɛdʒa/: [lɛdʒa] ‘ugly.F’
     metge /mɛdʒa/: [mɛdʒa] ‘doctor.M’
     metgessa /mɛdʒɛsə/: [mɛdʒɛsə] ‘doctor.F’
  c. Word-finally: /dʒ/ and the stop-plus-fricative sequence /dʒ/
     boig /bɔdʒ/: [bɔʃ] ‘crazy.M’
     lleig /lɛdʒ/: [lɛʃ] ‘ugly.M’

The analysis proceeds as follows. Three markedness constraints control sonority relations among segments: (a) the general sonority contour of the syllable, i.e. SONORITY-SEQUENCING (35a); (b) the sonority profiles in syllable contacts, i.e.

\(^{10}\) Recasens (1993: 160–161) proposes that all surface affricate realizations are biphonemic except word-final [ʃ] that alternates with intervocalic [ʒ], though he takes the traditional view that [ʃ] derives from /ʃ/ in these cases.
SYLLABLE-CONTACT (35b), which penalizes rising sonority transitions across syllables; and (c) the sonority distances between the segments of a complex onset, i.e. MINIMAL-SONORITY-DISTANCE\textsubscript{ONSET} (MSD\textsubscript{ONSET}) (35c), which, according to Wheeler (2005), in the case of Catalan permits only sequences with a sonority distance higher than or equal to seven points based on the scale in (36). The other relevant markedness constraints at play are NO-GEMINATE (35d), which militates against geminate segments; LAZY\textsubscript{V\_V} (35e), which favors lenition of voiced stops and affricates in intervocalic position; and NO-VOICED-CODA, already presented in (15a). LAZY\textsubscript{V\_V} targets single consonants but not geminates, since the extra C slot generated by gemination destroys the context for Laziness to apply.

(35) Relevant markedness constraints

a. SONORITY-SEQUENCING: Assign one violation mark for every onset whose sonority does not increase from the beginning to the nucleus of a syllable, and for every coda whose sonority does not decrease from the nucleus to the end of the syllable (see Clements 1990).

b. SYLLABLE-CONTACT: Assign one violation mark for every final segment of a syllable that is less sonorous than the initial segment of an immediately following syllable (see Murray and Vennemann 1983; Vennemann 1988; Clements 1990).

c. MINIMAL-SONORITY-DISTANCE\textsubscript{ONSET} (MSD\textsubscript{ONSET}): Assign one violation mark for every onset sequence C\textsubscript{1}C\textsubscript{2} where the value of C\textsubscript{2} – C\textsubscript{1} < 7 (see Wheeler 2005: 266).

d. NO-GEMINATE: Assign one violation mark for every geminate segment (see McCarthy and Prince 1995; Prince and Smolensky 2004; Wheeler 2005).

e. LAZY\textsubscript{V\_V}: Assign one violation mark for every voiced obstruent that is [–continuant] in intervocalic position.

(36) Sonority ranking (Catalan) (Wheeler 2005: 255)

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Glides</td>
<td>Tap</td>
<td>Laterals, trill</td>
<td>Nasals</td>
<td>Sibilant continuants</td>
<td>Non-sibilant continuant stops/sibilant continuants</td>
</tr>
</tbody>
</table>

The relevant faithfulness constraints at play are IDENT(voice) and IDENT (cont), already presented in (15b) and (15c), respectively; MAX (37a), which

militates against segment deletion; and UNIFORMITY (37b), which penalizes coalescence, as in the case of a stop-plus-fricative sequence becoming an affricate.

(37) Relevant faithfulness constraints
   a. MAX: Assign one violation mark for every segment in the input that has no correspondent in the output (see McCarthy and Prince 1995).
   b. UNIFORMITY: Assign one violation mark for every segment of the output that has multiple input correspondents (= no coalescence; see McCarthy and Prince 1995).

The constraint ranking at work is presented in (38) and justified throughout the tableaux (39)–(46) (see the ranking lattice in (47)).

(38) Ranking
   NO-VOICED-CODA, SONORITY-SEQUENCING, SYLLABLE-CONTACT, MSD<sub>ONS</sub>, MAX, LAZY<sub>V_V</sub>, NO-GEMINATE ≫ IDENT(voice), IDENT(cont) ≫ UNIFORMITY

The contrast between boja (39) and lletja (40) is captured through different inputs: with an affricate in the former, /bɔ́dʒ₁ə/, and a consonantal sequence in the latter, /ʎe₁dʒ₂ə/ (henceforth, we add subscripts to the relevant consonants for the sake of representational clarity). Given an input with an affricate, /bɔ́dʒ₁ə/ (39), LAZY<sub>V_V</sub> penalizes the presence of a single affricate between vowels because the affricate is associated with a single slot, (39b); however, the presence of a geminate affricate, (39c), does not violate LAZY<sub>V_V</sub> because the extra C slot of the geminate destroys the intervocalic context for Laziness. Nevertheless, candidate (39c) violates NO-GEMINATE. The ranking of LAZY<sub>V_V</sub> and NO-GEMINATE above IDENT(cont), which the grammatical candidate (39a) violates, is sufficient for the candidate with lenition to win. (Tableau (39) presents arguments for the ranking LAZY<sub>V_V</sub>, NO-GEMINATE ≫ IDENT(cont).)

(39) /bɔ́dʒ₁ə/: [bɔ́.ʒ₁ə] ‘crazy.f’

<table>
<thead>
<tr>
<th>/bɔ́dʒ₁ə/</th>
<th>NOVCD</th>
<th>SON</th>
<th>SYL</th>
<th>MSD&lt;sub&gt;ONS&lt;/sub&gt;</th>
<th>MAX</th>
<th>LAZY&lt;sub&gt;V_V&lt;/sub&gt;</th>
<th>NO-GEM</th>
<th>ID</th>
<th>ID</th>
<th>UNIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bɔ́.ʒ₁ə</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. bɔ́.dʒ₁ə</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td></td>
<td>L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. bɔ́d.ʒ₁ə</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td></td>
<td>L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Given an input with a consonantal sequence, /ʎeˈd1ʒə/ (40), SYLLABLE-CONTACT rules out candidate (40b) because the syllabic transition presents an increase of sonority, while MSD_{ONS} rules out candidate (40c) because the stop and the fricative onset consonants [d₁ʒ₂] are too close in sonority (i.e. a distance of four points according to the scale provided in (36)). Candidate (40d), with coalescence of the two input consonants /d₁ʒ₂/ into an affricate [d₃₁z₂], entails a violation of UNIFORMITY and, crucially, a violation of LAZY_{ V.V}. MAX rules out candidate (40e), where the input stop is lost. Candidate (40f), with a geminate affricate [d₁d₂ʒ₁], is ruled out by NO-GEMINATE and violates UNIFORMITY too. Hence, the winning candidate, (40a), though phonetically identical to the geminate affricate in (40f), maintains the stop consonant but affricates the fricative, [d₁d₃₁z₂], for which reason it only irrelevantly violates IDENT(cont). In our account, words like metge [mɛ̃d₁d₂ʒ₂] are analyzed like lletja, because, for the reasons mentioned above, they have a word-final lexical vowel too: /mẽd₁ʒ₂ə/. (Tableau (40) presents arguments for the ranking SYLLABLE-CONTACT, MSD_{ONS}, MAX >> IDENT(cont)).

(40) /ʎeˈd1ʒə/: [ʎeˈd₁d₂ʒ₂] ‘ugly.F’

<table>
<thead>
<tr>
<th></th>
<th>NOVC</th>
<th>CODA</th>
<th>SON</th>
<th>SEQ</th>
<th>SYL</th>
<th>CONT</th>
<th>MSD</th>
<th>MAX</th>
<th>LAZY</th>
<th>NOGEM</th>
<th>ID</th>
<th>ID</th>
<th>UNIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>ʎẽd₁d₂ʒ₂</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>ʎẽd₁ʒ₂ə</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td>*!W</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>ʎẽd₁d₂ʒ₂</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td>*!W</td>
<td>L</td>
<td>*W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>ʎẽd₁d₂ʒ₂</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td>*!W</td>
<td>L</td>
<td>*W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>ʎẽd₁ʒ₂ə</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td>*!W</td>
<td>L</td>
<td>*W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f.</td>
<td>ʎẽd₁d₂ʒ₂</td>
<td>*!W</td>
<td>L</td>
<td></td>
<td>*!W</td>
<td>L</td>
<td>*W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that the fused affricate segment in (40d) occupies one slot, while the correspondents in the input occupy two slots; therefore there is a violation of UNIFORMITY. But the root nodes of the input and the candidate (40d) stand in perfect correspondence; hence there is no violation of IDENT(cont). Contrariwise, in (40a), IDENT(cont) is violated because the second segment has a [−continuant] feature in the output, which is not present in the input.

---

12 In candidate (40a) the stop (d₁) agrees in place of articulation with the following affricate. In the tableaux, we do not indicate either this assimilation or the constraints responsible for it.
The same analysis applies to all other alveolar or palatal stop-plus-fricative sequences, whether they appear within words (homomorphemic or heteromorphemic) or across words, which in the case of the voiced sets end up with the same phonetic surface-geminate effect (e.g. pot jugar /poði̯ ʒuɡáɾ/: [poði̯ ʒuɡáɾ] ‘(s/he) can play’, horitzó /uɾiɾi ʒəɾ/ [uɾiɾi ʒəɾ] ‘horizon’, set zeros /sɛɾəɾu̯/ [sɛɾəɾu̯] ‘seven zeros’).

The fact that in word-final position words with an affricate input, like boig in (41), end up having the same phonetic outcome as words with a consonantal sequence input, like lleig in (42), is due to the fact that candidates with a voiceless fricative, i.e. (41d) and (42f), violate IDENT(cont). In (42), the candidate with a voiceless fricative and stop deletion, (42e), crucially violates MAX. Candidates (42b) and (42d) violate SONORITY-SEQUENCING. Additionally, in both tableaux, any candidate with a word-final voiced obstruent violates NO-VOICED-CODA, as occurs with (41b), (41c), (42b), and (42c). (Tableaux (41) and (42) present an argument for the ranking NO-VOICED-CODA >> IDENT(voice); tableau (42) further demonstrates the ranking SONORITY-SEQUENCING >> UNIFORMITY, as does tableau (43) below as well.)

(41) /bódʒəɾ/ [bójɾ] ‘crazy.M’

| /bódʒəɾ|  | NOVCD | SON | SYL | MSD | MAX | LAZY | NO | ID | ID | Unif |
|--------|------|-------|-----|-----|-----|-----|-----|----|----|-----|
| a. bójɾ |     |      |     |     |     |     |     |    | *  |     |     |
| b. bódʒəɾ | *!W |     |     |     |     |     |     |    | L  |     |     |
| c. bójɾ | *!W |     |     |     |     |     |     |    | L  | *W  |     |
| d. bójɾ |     |     |     |     |     |     |     |    | *  | *!W |     |

(42) /ʎeði̯ ʒəɾ/ [ʎe̯tɾ] ‘ugly.M’

| /ʎeði̯ ʒəɾ|  | NOVCD | SON | SYL | MSD | MAX | LAZY | NO | ID | ID | Unif |
|-----------|------|-------|-----|-----|-----|-----|-----|----|----|-----|
| a. ʎe̯tɾ |     |      |     |     |     |     |     |    | *  | *   |     |
| b. ʎeði̯ ʒəɾ | *(!W | *(!W |     |     |     |     |     |    | L  | L   |     |
| c. ʎeði̯ ʒəɾ | *!W |     |     |     |     |     |     |    | L  |     |     |
| d. ʎe̯tɾ | *!W |     |     |     |     |     |     |    | *  | L   |     |
| e. ʎe̯ɾ |     |     |     |     |     |     | *!W |    | *  | L   |     |
| f. ʎe̯ɾ |     |     |     |     |     |     | *!W |    | *  | *!W |     |
All other stop-plus-fricative sequences in word-final position become an affricate as an effect of UNIFORMITY being ranked lower than SONORITY-SEQUENCING and MAX, as shown with the word gavatx in (43). The same holds for heteromorphemic sequences (e.g. gats [gəts] ‘cats’).

(43) /gəbátʃ12/: [gəbátʃ12] ‘French.M (slang)’

<table>
<thead>
<tr>
<th>/gəbátʃ12/</th>
<th>NOVCD CODA</th>
<th>SON SEQ</th>
<th>SYL CONT</th>
<th>MSD ONS</th>
<th>MAX</th>
<th>LAZY V_V</th>
<th>NO GEM</th>
<th>ID [vc]</th>
<th>ID [ct]</th>
<th>UNIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. gəbátʃ12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. gəbátʃ12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>!W</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>c. gəbátʃ12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>d. gəbátʃ12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

When the inputs display word-final single fricatives, as in fluix (44) and gris (45), there is no reason to turn them into affricates, because this change incurs a violation of IDENT(cont), as (44b) and (45c) show. Candidates with word-final voiced obstruents, though they may be fully faithful like (45b), are ruled out by the high-ranked constraint NO-VOICED-CODA. (Tableau (45) presents an argument for the ranking NO-VOICED-CODA >> IDENT(voice), as did the previous tableaux (41) and (42).)

(44) /fluʃ1/: [fluʃ1] ‘loose.M’

<table>
<thead>
<tr>
<th>/fluʃ1/</th>
<th>NOVCD CODA</th>
<th>SON SEQ</th>
<th>SYL CONT</th>
<th>MSD ONS</th>
<th>MAX</th>
<th>LAZY V_V</th>
<th>NO GEM</th>
<th>ID [vc]</th>
<th>ID [ct]</th>
<th>UNIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. fluʃ1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. fluʃʃ1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(45) /griz1/: [gɾiz1] ‘grey.M’

<table>
<thead>
<tr>
<th>/griz1/</th>
<th>NOVCD CODA</th>
<th>SON SEQ</th>
<th>SYL CONT</th>
<th>MSD ONS</th>
<th>MAX</th>
<th>LAZY V_V</th>
<th>NO GEM</th>
<th>ID [vc]</th>
<th>ID [ct]</th>
<th>UNIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. griz1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. griz1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>c. grǐs1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*!W</td>
<td></td>
</tr>
</tbody>
</table>
Finally, stop-plus-fricative voiceless sequences in intervocalic position, such as the one in *gavatxa* (46), are realized with a single affricate (46a). In our analysis, SYLLABLE-CONTACT dominating UNIFORMITY crucially rules out candidate (46b) in favor of the winning candidate (46a); MSD_{CONS} dominating UNIFORMITY favors (46a) when confronted with candidate (46c), with a complex stop-plus-fricative onset; MAX dominating UNIFORMITY gives preference to (46a) over a fricative output (46d); IDENT(cont) dominating UNIFORMITY favors (46a) over candidate (46e), which maintains the stop and affricates the fricative; and NO-GERMINATE dominating UNIFORMITY favors (46a) over candidate (46f), with a geminate affricate (by transitivity of domination, the ranking is SYLLABLE-CONTACT, MSD_{CONS}, MAX, NO-GERMINATE ≫ IDENT(cont) ≫ UNIFORMITY). Words like *cotxe* [koˈtʃe] ‘car’ are analyzed similarly, because, as noted above, they are considered to have a word-final lexical vowel: /koˈtʃe/. The same analysis holds for voiceless alveolar sequences within words (e.g. *lletsó* /ʎeˈtʃo/: [ʎeˈtʃo] ‘thistle, dandelion’) as well as for similar voiceless sequences across words (e.g. *barret xinès* [baɾeˈtʃin.əs] ‘Chinese hat’, *compra’t segells* [koˈɾmaɾəˈʃeʎəs] ‘buy.2SG.IMP=yourself stamps’).

13

(46) /ɡəβátʃəɑ:/ [ɡəβ̥əˈʃəɑ] ‘French.F (slang)’

<table>
<thead>
<tr>
<th>/ɡəβátʃəɑ/</th>
<th>NoVC</th>
<th>CODA</th>
<th>SON</th>
<th>SEQ</th>
<th>SYL</th>
<th>CONT</th>
<th>MSD_{CONS}</th>
<th>MAX</th>
<th>Lazy</th>
<th>No</th>
<th>GEM</th>
<th>Id</th>
<th>[vc]</th>
<th>Id</th>
<th>[ct]</th>
<th>Unif</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>gaβ̥əˈʃəɑ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>gaβ̥əˈʃəɑ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>gaβ̥aˈtʃəɑ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>gaβ̥əˈʃəɑ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>gaβ̥əˈʃəɑ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>gaβ̥əˈʃəɑ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The final ranking lattice is presented in (47).

13 As mentioned in Section 2 and Section 3.2.2, voiceless affricate lengthening in intervocalic position is possible but, unlike in the case of voiced affricates, it is variable and is mainly conditioned by the position of stress. It is hence interpreted as a low-level phonetic effect, whose study and formalization go beyond the scope of this paper. A possible analysis of variation could involve free ranking between IDENT(cont) and UNIFORMITY.
To close, it is worth noting that in our account, the possibility of ending up having surface-geminate affricate outcomes derives from the presence of two-slot inputs (i.e. stop-plus-fricative sequences), while the possibility of having fricative lenition derives from one-slot inputs (i.e. the affricate /dʒ/). Jiménez (1996, 1999) ends up positing a similar interpretation for Valencian varieties that present surface-geminate affricates for the alveolar series, which are derived from /ts/ and /dz/ consonant sequences (as in lletsó [ʎɛtsô], horitzó [ɔriddʒó]), but single affricates for the palatal series, which are derived from /ʃ/ and /ʒ/ (as in gavatxa [ɡaβatʃa], boja [boʒa], lletja [ʎɛtʃa]).

5 Conclusions

In this paper, we have provided an analysis of the [ʒ] ~ [ʃ] alternation in Catalan together with the interpretation of all sibilants. The main advantage of our analysis is that the palatal voiced fricative–affricate alternation derives from a weakening effect in the most suitable lenition-favoring context, i.e. in intervocalic position. Lenition effects in this context, including deaffrication, are well attested in Romance and other languages, and this goes in line with the spirantization of voiced stops that takes place in the same position in Catalan. A further advantage of our analysis is that the constraints that are needed to account for the whole distribution of sibilants are general constraints that are well grounded in the literature for other phenomena.

All the analyses that try to find a unified explanation for the behavior of sibilants in Catalan and attribute intervocalic [ʒ] to lenition are forced to resort to different lexical representations in the voiced palatal set. Some authors attribute it to the coexistence of single and geminate voiced palatal affricate inputs (/dʒ/ and /ddʒ/), with allomorphy in some items (/dʒ/ and /ddʒ/) if word-final vowel epenthesis is assumed. In our view, this is an unnecessary move,
not only because there is no conclusive evidence for synchronic word-final epenthesis but also because geminate inputs are rare in Catalan and the language needs nonetheless an affrication process that turns stop-plus-fricative sequences into affricates across morphemes and across words. For these reasons, we have proposed to capture the lexical differences of voiced palatal sibilants through /dʒ/ inputs (for the alternating [ʒ] ~ [ʧ] cases) that contrast with single fricative inputs (/ʃ/, /ʒ/) and inputs with stop-plus-fricative sequences (/ʧ/, /dʒ/). By contrast, the alveolar series only shows single fricative inputs and consonantal sequences (/s/, /z/, /ts/, /dz/). An apparent handicap of our proposal is that /dʒ/ is the only affricate input and it displays a limited distribution, since it only appears word-finally and intervocically. But, as we showed in Section 2, other sibilants present a defective or low-frequency distribution, and we could add to this that conservative dialects, such as most Valencian varieties, have only /dʒ/ and no /ʒ/. A clear advantage of our proposal is that in all dialects the occurrence of surface-geminate affricates derives from stop-plus-fricative (two-slot) sequences. Hence, overall, our analysis fits better not only into the characteristics of the phonology of Catalan but also into the typology of lenition effects.

**Acknowledgements:** We thank Jesús Jiménez, Violeta Martínez-Paricio, Joan Mascaró, Clàudia Pons-Moll, and Francesc Torres-Tamarit for their comments and suggestions regarding the first version of this contribution.

**Funding:** The authors acknowledge support from the Spanish State Research Agency (AEI) and European Regional Development Fund (projects FFI2016-76245-C3-1-P and FFI2016-76245-C3-3-P), and the Catalan Government (research groups 2017 SGR 634 and 2017 SGR 942).

**References**


