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# OCP effects and the representation of affricates in Basque

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The representation of affricates remains an unsettled issue in phonology. The main question is whether affricates should be treated as simple or complex segments. In the former view, affricates are stops specified for an additional feature, such as [strident]; in the latter, affricates are complex segments specified for [+continuant] and [–continuant] in an unordered fashion. Using the framework of Optimality Theory, this paper investigates similarity avoidance effects in Basque under the two competing theories of representation. The posited OCP effects involve the avoidance of [strident] and [–continuant] clusters. Importantly, the complex segment approach requires the use of two additional constraints militating against [+continuant] and [+obstruent] clusters. The analysis successfully accounts for the imperfective formation data as well as for other processes in Basque, such as simplification of stop clusters, stop+fricative coalescence and lenition of voiced obstruents. Additionally, the article discusses asymmetries in consonant mutations connected with the OCP effects. In particular, the preference of surface fricative+stop clusters over stop+fricative clusters is attributed to a high-ranked markedness constraint, NoAffricateContrast. An important conclusion of the analysis is that the complex segment approach creates unnecessary complications, as the parallel framework allows to maintain satisfactory generalizations within the simple segment approach.

# 1 Introduction

The Obligatory Contour Principle (OCP; Leben 1973; Goldsmith 1976) was first formulated as a restriction on the similarity of adjacent tones. Subsequent research on dissimilation established that the spectrum of possible dissimilatory processes is much broader (e.g., Suzuki 1998). For instance, similarity avoidance can refer to the features shared by segments and function in the domain of strict segmental adjacency, syllabic adjacency or morphological adjacency (see Alderete & Frisch 2007; Czaplicki forthcoming). An example of an OCP-driven[1] allomorph selection can be found in Spanish, where two adjacent clitics cannot both contain the lateral /l/. Therefore, *le* (masc./fem. indirect obj.) is replaced by *se* when followed by *lo* or *la* (masc. and fem. direct obj., respectively); for instance, **le lo di* → *se lo di* 'I gave it to him/her' (cf. Grimshaw 1997; Manzini 2014).

This paper is concerned with the mechanism of similarity avoidance in consonant clusters in Basque, which hinges upon the phonological representation of affricates. For instance, in Basque, affricates are simplified to plain stops after sibilants: /s + t͡s/ → /s + t/, e.g., /ikus + t͡sen/ → [ikusten] 'see' imperf. Such a process can be attributed either to (i) the avoidance of adjacent [ + continuant] segments or to (ii) the avoidance of adjacent [strident] segments. The two analyses spring from the assumed theories of representation. The former approach treats affricates as complex segments specified for the two contradicting values of the feature [ ± continuant] (Hualde 1991; Lombardi 1990; van de Weijer 1992). In the latter approach, on the other hand, affricates are stops specified for the feature [strident] (Jakobson *et al.* 1952; LaCharité 1993; Rubach 1994; Clements 1999; Krajewska 2010). The goal of the current paper is to examine the data from Basque in light of these competing theories. The particular processes discussed in the ensuing sections include imperfective formation, simplification of stop clusters, coalescence of stop + fricative clusters and voiced obstruent lenition. In contrast to previous analyses of these data, which assumed rule-based derivational frameworks (Hualde 1988b; 1991; Archangeli & Pulleyblank 1987; Lombardi 1990; van de Weijer 1992; Artiagoitia 1993; LaCharité 1993), the current paper uses parallel evaluations of output candidates based on constraint violations in the framework of Optimality Theory (OT; Prince & Smolensky 2004). The advantages of OT over rule-based approaches have been shown in the literature of the past two decades and hence they are not the main focus of the present article (e.g., McCarthy & Prince 1995; Rubach 1997; Kager 1999; McCarthy 2001; Bermúdez-Otero & Hogg 2003; Łuszczek forthcoming; among others). Regarding the theory of representation, the paper assumes that features are organized hierarchically on autosegmental tiers (Clements 1985; Sagey 1986).

The article is organized as follows. Section 2 outlines the representation of affricates in phonological theory. Section 3 examines the alternations in Basque imperfective formation under

[1] I use the terms *similarity avoidance*, *dissimilation* and *OCP* interchangeably.

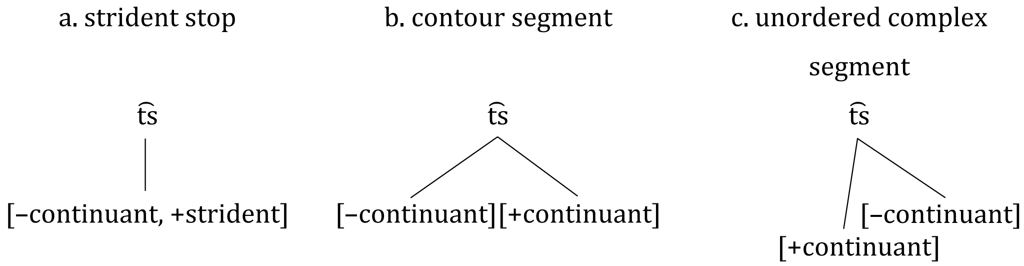
two competing representational theories: the strident stop approach and the nonlinear organization of affricates. Section 4 further develops the ranking of constraints based on three other processes in Basque: simplification of stop clusters, stop + fricative coalescence and lenition of voiced obstruents. Section 5 discusses nasal assimilation and its interaction with the OCP effects. Section 6 considers an alternative syllable-based account of the Basque data. Section 7 proposes possible solutions to a residual issue found in the imperfective paradigm, that is, the behavior of *n*-class verbs, which cannot be explained by reference to OCP. Section 8 presents the main conclusions.

## 2 Affricates in phonological theory

The representation of affricates has been an unsettled issue in phonology for almost a century. This section summarizes the predictions of three theories:[2] (i) affricates are stops specified for an additional feature, e.g., stridency (Jakobson *et al.* 1952; Chomsky & Halle 1968); (ii) affricates are contour segments specified for the feature [–continuant] on the left edge and [ + continuant] on the right edge (Sagey 1986); (iii) affricates are complex segments specified for the features [ + continuant] and [–continuant], with no ordering of these features within the segment (Hualde 1991; Lombardi 1990). Importantly, all of the aforementioned theories and the arguments developed therein advocate a monosegmental status of affricates. In other words, affricates are single segments and they contrast phonologically with stop + fricative clusters, which are two separate segments.

Let us consider the representations in (1) and discuss the consequences of each approach.

(1) *Representation of affricates*




The representation similar to (1a) was first proposed in Jakobson *et al.* (1952), where affricates were treated as stops specified for an additional feature, such as [strident].[3] In the subsequent

[2] For an exhaustive overview, see Berns (2016).

[3] The feature [strident] is an acoustically defined feature that characterizes sounds of high frequency noise (Jakobson *et al.* 1952; Chomsky & Halle 1968 and others, summarized in LaCharité 1993). The notion of a *strident stop* itself, however, is purely phonological. It means that the phonological contrast between stops and affricates lies in the feature [strident]. In this view, the feature [continuant] is relevant only in contrasting stops and fricatives. The phonetic realization of affricates is due to phonetic implementation rules.

works on the theory of representation, it was proposed that features are organized hierarchically on autosegmental tiers (Clements 1985; Sagey 1986). (1a) is a simplified version of the feature-geometric representation, where the phonetic symbol /t͡s/ represents the root node and the features are attached to it with the use of association lines. Advocates of representation (1a) emphasize that affricates typologically behave as stops and hence should not be considered continuants (LaCharité 1993; Rubach 1994; Clements 1999; Kehrein 2002; Berns 2013; 2016; Kim *et al.* 2015).

The phonetic realization of affricates, which includes a complete closure followed by a noisy release (frication), gave rise to the theory of affricates as contour segments (the ordered organization theory) (Sagey 1986). According to this view, visualized in (1b), affricates are single complex segments behaving as stops on their left edge and as fricatives on their right edge. However, the predictions of this theory have been repeatedly falsified (e.g., Lombardi 1990; Hualde 1991; Rubach 1994).

The final approach, shown in (1c), is a development of the ordered organization theory and is often dubbed the nonlinear or unordered organization theory (Hualde 1988a; 1991; Lombardi 1990). It argues that affricates bear the two features proper to stops and fricatives, i.e., [–continuant] and [+continuant], respectively. However, in contrast to its predecessor, the nonlinear organization theory claims that these features are not crucially ordered within the segment. Accordingly, the prediction is that affricates pattern with stops and with fricatives to the same extent, regardless of the edge. That is, they do not show contour (or edge) effects.

While the representation of affricates as simple segments, as in (1a), creates no further theoretical problems, the complex segment approaches in (1b) and (1c) require additional discussion. For instance, assuming the nonlinear organization of affricates, the status of the feature [±continuant] becomes unclear. It seems that it must be treated as an exceptional feature in that a segment can be specified for its two contradicting values. Moreover, the complex segment approach is straightforwardly more complicated than the simple segment representation as more structure is postulated. Therefore, in order to posit the former, the latter must be first proven inadequate.

The consensus regarding the representation of affricates has not been reached. Since the theory of the ordered organization of affricates has been rejected based on various examples from different languages (Lombardi 1990), the ensuing analysis is limited to the following alternatives: affricates are strident stops or affricates are complex segments specified for the two contradicting values of the feature [±continuant] in an unordered fashion. The main point of the discussion revolves around (i) descriptive adequacy and (ii) the economy of argumentation, that is, Occam's razor. Descriptive adequacy is achieved when the data are accounted for within a given theory. The economy of argumentation, on the other hand, assesses the amount of redundancies in a given solution as well as the complexity of the theoretical machinery employed. As shown in the ensuing analysis, both theories of representation fare well in handling the Basque data.

However, the unordered component theory creates more analytical problems than the strident stop approach. For instance, it requires the use of local constraint conjunction (Smolensky 1997), an auxiliary theory to Optimality Theory. Moreover, based on independent evidence adduced in Section 4.3, the feature [strident] must be included in the phonological description of Basque, which renders the specification of affricates as [+continuant] redundant. In other words, there is no reason for postulating the more complicated representation as all the data are accounted for within the simple segment approach.

Previous analyses of the Basque data used in this article favored the unordered organization theory (e.g., Hualde 1991). However, the main arguments came from the framework of rule-based phonology. As shown in the following sections, these arguments are no longer present in an output-oriented parallel theory, such as Optimality Theory, thus leaving the question regarding the representation of affricates open.

# 3 Basque imperfective formation

This section presents the data from Basque imperfective formation and proposes an Optimality Theoretic (OT) analysis under two alternative assumptions described in the previous section: (i) affricates bear the features [–continuant, strident] or (ii) affricates are complex segments with phonologically unordered features [–continuant] and [+continuant]. Importantly, in both theories affricates are single segments.[4] In the strident stop approach, [strident] is treated as a privative feature. The predictions of a binary feature [strident] and the rationale behind the current assumption are discussed in Section 4.

In Basque orthography, <z s x> correspond to voiceless fricatives [s̻ s̺ ʃ] (laminal, apical and palato-alveolar, respectively) and <tz ts tx> to voiceless affricates [ts̻ ts̺ tʃ] (laminal, apical and palato-alveolar, respectively). Since this is not crucial to the present discussion, I simplify the facts and transcribe both the laminal and the apical alveolar stridents as [s] and [t͡s], and the palato-alveolars as [ʃ] and [t͡ʃ]. For an overview of Basque sound inventory, see Hualde (2003a).[5]

Consider the first set of examples given in (2).

| (2) | | *Perfect participle* | *Imperfective* | *Gloss* |
|---|---|---|---|---|
| | a. | garbi + tu | garbi + tzen | ‘wash’ |
| | | agur + tu | agur + tzen | ‘greet’ |
| | | gal + du | gal + tzen | ‘lose’ |
| | | ken + du | ken + tzen | ‘remove’ |

[4] I do not develop further the argument for treating affricates as single segments in Basque since this topic has been discussed at length elsewhere (e.g., Hualde 1991 Section 5.2).

[5] As a reviewer points out, Basque exhibits palatal stops /c ɟ/ that are produced with a noisy release. Importantly, these stops pattern with other non-continuant segments and not with strident segments. Therefore, regardless of their phonetic realization, they must be phonologically non-strident.

| | | | |
|---|---|---|---|
| b. | ekarr + i | ekar + tzen | ‘bring’ |
| | ibil + i | ibil + tzen | ‘walk’ |
| c. | ireki | ireki + tzen | ‘open’ |
| | jaiki | jaiki + tzen | ‘get up’ |
| d. | jaio | jaio + tzen | ‘be born’ |
| | bota | bota + tzen | ‘throw’ |

The imperfective is formed by the addition of the suffix *–tzen* [t͡sen] to the root of the verb. The verbs in (2c) are particularly problematic. In the perfect participle, they are similar to the verbs in (2b). For instance, Hualde (2003b) treats them as containing the suffix *–i*. However, these examples are best analyzed as containing *i* in the root, hence //ireki// rather than //irek + i// ‘open’ (see Trask 1995). Even though the verbs in (2c) look similar to the verbs in (2b) (e.g., *ibil + i* ‘walk’), the *–ki* verbs never alternate and the final *i* is always present, regardless of the phonological context (cf. *ibil + i* ‘to walk’ – *ibil + era* ‘a walk’ *vs. ireki* ‘to open’ – *ireki + era* ‘an opening’).[6] This makes them morphologically idiosyncratic in that they pattern with the structurally transparent zero-ending verbs in (2d) (e.g., //bota// ‘throw’). Therefore, for the purposes of this analysis, both the verbs in (2c) and (2d) are viewed as bare stems without a suffix indicating the perfect participle.

Now, let us consider the data in (3).

| (3) | *Perfect participle* | *Imperfective* | *Gloss* |
|---|---|---|---|
| | ikus + i | ikus + ten | ‘see’ |
| | eros + i | eros + ten | ‘buy’ |
| | irabaz + i | irabaz + ten | ‘win’ |
| | has + i | has + ten | ‘start’ |

The imperfective suffix attached to the verbs in (3) surfaces as [ten], exhibiting a consonant alternation from the underlying affricate //t͡s// presented in (2). The alternative would be to posit //ten// as the underlying representation (UR) of the suffix. Such an approach, however, cannot be justified, since there is no phonological reason for a mapping //t// → [t͡s] in the contexts in (2). Crucially, we would need to posit a rule stating (schematically) t → t͡s / V_V, which predicts the absence of intervocalic dental stops in Basque; however, this is counterfactual, since such stops are present in the language, e.g., *bete* ‘fill’. Therefore, under the assumptions of Generative Phonology, the suffix must contain an underlying affricate. In terms of SPE formalism (*The Sound Pattern of English*; Chomsky & Halle 1968), the rules in (4) can be proposed for Basque.[7]

[6] The only alternation of the final *i* in the *–ki* verbs is the finite form of *eduki* ‘contain’, e.g., *daduka* ‘he has it’ (Hualde 2003b:199).

[7] SPE rules are given only for the puposes of presentation; I abstract away from the details of rule-based analyses.

(4) a. *strident stop approach*

[–cont, +strid] → [–strid] / [+strid] _

b. *nonlinear organization approach*

[–cont, +cont] → [–cont] / [+cont] _

The relevant OT constraints are given in (5):

(5) a. *strident stop approach*

$\text{OCP}_{[\text{strid}]}$: Assign a violation mark for every two adjacent stridents.

b. *nonlinear organization approach*

$\text{OCP}_{[+\text{cont}]}$: Assign a violation mark for every two adjacent continuants.

The effects of constraint (5a) can be found in English. The formation of plural nouns in English is conditioned by the prohibition of adjacent strident segments. The suffix /ɪz/ is added to stems ending in a strident fricative or an affricate (e.g., *bus+es* /bʌs+ɪz/, *batch+es* /bæt͡ʃ+ɪz/), while the allomorphs /s/ or /z/ are present elsewhere. Crucially, stems ending in non-strident fricatives take the consonantal allomorphs (e.g., *belief+s* /bɪlif+s/, *path+s* /pæθ+s/).[8] These examples illustrate that the OCP constraint in English prohibits two adjacent strident segments rather than two [+continuant] segments, as in (5b) (see Lombardi 1990).[9]

As mentioned in Section 1, dissimilation may have various domains of application, e.g., syllable adjacency or segmental adjacency. The irrelevance of syllable adjacency in regards to the Basque data is demonstrated by examples such as *bizi+tza* [bisi+t͡sa] 'living' (noun) or *dantza+tzen* [dant͡sa+t͡sen] 'dance' (imperf.), where two syllables with similar/identical strident onsets are found immediately next to each other. It seems, then, that in Basque the relevant domain of application of OCP is segmental adjacency (arguably, segmental adjacency in Derived Environment).

The evaluation of *ikusten* //ikus+t͡sen// 'see' (imperf.) is shown in (6). All tableaux use phonetic transcription.

(6) //ikus+t͡sen// → [ikusten] 'see' imperf.

i. *strident stop*

| ikus+t͡sen | $\text{OCP}_{[\text{strid}]}$ | $\text{IDENT}_{\text{C}}$ |
|---|---|---|
| a. ikust͡sen | *! | |
| ☞ b. ikusten | | * |

[8] Although traditionally [f] has been considered strident (e.g., Jakobson *et al.* 1952; Chomsky & Halle 1968), its status is not entirely clear in phonology and the patterning of the English plural suffix can serve as an argument in favor of treating [f] as non-strident.

[9] English actually allows two adjacent stridents in some contexts, e.g., *fish soup*. Therefore, the OCP effect found in English requires morphological conditioning, which can be achieved, for instance, by introducing a level distinction in OT (Kiparsky 1997; Rubach 1997).

ii. *nonlinear organization*

| ikus + t͡sen | $OCP_{[+cont]}$ | IDENT$_C$ |
|---|---|---|
| a. ikust͡sen | *! | |
| ☞ b. ikusten | | * |

Tableaux (6) yield the attested outputs. The winners fare well on OCP, while violating a low-ranked faithfulness constraint, IDENT$_C$, which requires the identity of consonantal features between the input and the output. Candidates (6i-a) and (6ii-a), in turn, fatally violate the high-ranked OCP constraints.

Looking at (6ii), a potential problem regarding the scope of $OCP_{[+cont]}$ can be spotted. It is unclear whether sonorants (including vowels) should participate in $OCP_{[+cont]}$ violations. Consider the evaluation of an example from (1a) given in (7).

(7) //agur + t͡sen// → [agurt͡sen] 'greet' imperf.

i. *strident stop*

| agur + t͡sen | $OCP_{[strid]}$ | IDENT$_C$ |
|---|---|---|
| ☞ a. agur + t͡sen | | |
| b. agur + ten | | *! |

ii. *nonlinear organization (failed evaluation)*

| agur + t͡sen | $OCP_{[+cont]}$ | IDENT$_C$ |
|---|---|---|
| ☹ a. agur + t͡sen | *! | |
| ☜ b. agur + ten | | * |

Assuming the traditional feature specification for rhotics, /r/ should be treated as a continuant.[10] It means that a significant disparity between the discussed theories emerges. As demonstrated in (7), the strident stop approach finds no difficulty in accounting for the lack of alternation in the attested output (7i-a). Conversely, the nonlinear approach excludes the attested output (7ii-a) due to its $OCP_{[+cont]}$ violation incurred by the rhotic + affricate cluster. The same problem arises when a vowel (presumably, a [+continuant] segment) is adjacent to an affricate, as in [et͡ʃe] 'house'. One solution to this problem is to posit a restriction on $OCP_{[+cont]}$, which must be active only for obstruents. This can be achieved through constraint conjunction (Smolensky 1997), an auxiliary theory to OT. Given two constraints, A and B, the conjoined constraint A&B is violated only if the two sub-constraints are violated at the same time. Assuming an additional OCP constraint

[10] Independent evidence in favor of this view is presented in Section 4.3.

that militates against adjacent obstruents, $\text{OCP}_{[+\text{obstr}]}$, let us examine the violations incurred by different outputs in (8).

(8) *OT constraint conjunction*

| | $\text{OCP}_{[+\text{cont}]}\&\text{OCP}_{[+\text{obstr}]}$ | $\text{OCP}_{[+\text{cont}]}$ | $\text{OCP}_{[+\text{obstr}]}$ |
|---|---|---|---|
| a. s + a | | * | |
| b. s + t | | | * |
| c. s + s | * | * | * |

Candidates (8a) and (8b) violate individual OCP constraints, $\text{OCP}_{[+\text{cont}]}$ and $\text{OCP}_{[+\text{obstr}]}$, respectively. Candidate (8c), on the other hand, is in violation of both OCP constraints and hence incurs an additional violation of the conjoined constraint $\text{OCP}_{[+\text{cont}]}\&\text{OCP}_{[+\text{obstr}]}$. OT constraint conjunction has been criticized for its arbitrariness (e.g., Rubach 2017). Particularly, there is no limit to which constraints can be conjoined and, in consequence, a cohort of absurd constraints can be generated rendering the theory too powerful. Nevertheless, since there is no straightforward solution to the ranking paradox in (7), I assume the constraint conjunction theory. However, this must be treated as a downside of the nonlinear organization approach since no such complication is needed with the strident stop representation. For the reasons of space, the remaining tableaux use the notation $\text{OCP}_{[+\text{cont},\ +\text{obstr}]}$ instead of the proper $\text{OCP}_{[+\text{cont}]}\&\text{OCP}_{[+\text{obstr}]}$.

Having established the drivers of the alternation, let us consider the data in (9). Recall that the imperfective suffix contains an underlying affricate //t͡s//.

(9)

| *Perfect participle* | *Imperfective* | *Gloss* |
|---|---|---|
| utz + i | uz + ten | ‘leave’ |
| itx + i | ix + ten | ‘close’ |
| irakats + i | irakas + ten | ‘teach’ |
| jaits + i | jais + ten | ‘drop’ |

In addition to the suffix alternation //t͡s// → [t], the data in (9) exhibit stem alternations. Specifically, stem affricates become fricatives: *utz + i* [ut͡s + i] ‘leave’ → *uz + ten* [us + ten] ‘leave’ (imperf.); *itx + i* [it͡ʃ + i] ‘close’ → *ix + ten* [iʃ + ten] ‘close’ (imperf.). In SPE formalism, the rules in (10) can be formulated.

(10) a. *strident stop approach*

[–cont, +strid] → [+cont] / _ [–cont]

b. *nonlinear organization approach*

[–cont, +cont] → [+cont] / _ [–cont]

The rules in (10) express another dissimilatory process. This time, however, the goal is to avoid stop clusters. Indeed, stop clusters are not attested in the lexicon of Basque (with some exceptions discussed below). The relevant OT constraint, given in (11), is common to the two competing representations. A similar constraint is proposed in Fukazawa's (2001) account of OCP effects in Yucatec Maya.

(11) OCP$_{[-\text{cont}]}$: Assign a violation mark for every two adjacent non-continuants.

In Basque, the constraint in (11) is not free of exceptions. Although OCP$_{[-\text{cont}]}$ successfully accounts for the data presented in this section (and is further confirmed by the phonostylistic and word-formation data adduced in Section 4), it is not fully obligatory. For instance, recent borrowings and compounds may contain clusters of adjacent stops, e.g, *kontzeptu* 'concept' or *webgune* 'website'. These facts can constitute arguments in favor of, for instance, level distinction in OT (Kiparsky 1997; Rubach 1997; Bermúdez-Otero 1999), whereby OCP$_{[-\text{cont}]}$ would take effect only in Derived Environment. This paper, however, is limited to the analysis in classic OT.

The data in (9) show two processes in action: OCP$_{[\text{strid}]}$, alternatively OCP$_{[+\text{cont}]}$, is responsible for the mapping //t͡s// → [t] in the suffix and OCP$_{[-\text{cont}]}$ assures the change of the stem affricate into a fricative. The evaluations of candidates for *uzten* //ut͡s + t͡sen// 'leave' (imperf.) are given in tableaux (12). Dotted lines indicate that the ranking of constraints is irrelevant or has not been established.

(12) //ut͡s + t͡sen// → [usten] 'leave' imperf.

i. *strident stop*

| ut͡s + t͡sen | OCP$_{[\text{strid}]}$ | OCP$_{[-\text{cont}]}$ | IDENT$_C$ |
|---|---|---|---|
| a. ut͡st͡sen | *! | * | |
| b. ut͡sten | | *! | * |
| c. ust͡sen | *! | | * |
| ☞ d. usten | | | ** |

ii. *nonlinear organization*

| ut͡s + t͡sen | OCP$_{[+\text{cont}, +\text{obstr}]}$ | OCP$_{[-\text{cont}]}$ | IDENT$_C$ |
|---|---|---|---|
| a. ut͡st͡sen | *! | * | |
| b. ut͡sten | | *! | * |
| c. ust͡sen | *! | | * |
| ☞ d. usten | | | ** |

So far, the ranking functions correctly and both theories work in parallel. Each of the attested outputs, (12i-d) and (12ii-d), violates the low-ranked identity constraint twice since each changes two input features on consonants. In the strident stop approach, the input feature [–continuant] of the stem affricate is changed into [+continuant] and the input [strident] of the suffix affricate is delinked. In the nonlinear organization approach, the feature [–continuant] of the stem affricate is delinked and the feature [+continuant] is delinked from the suffix affricate. The remaining contenders are eliminated due to their violations of OCP.

At this point, one more issue remains: the question of directionality, as shown in (13). It seems that the current ranking makes no distinction between outputs containing a stop+fricative cluster and those containing a fricative+stop cluster. The irrelevant candidates violating the undominated OCP constraints are omitted. The problem is illustrated using the strident stop approach.

(13) i. //ikus+t͡sen// → [ikusten] 'see' imperf.

| $ikus_1 + \widehat{ts}_2en$ | $OCP_{[strid]}$ | $OCP_{[–cont]}$ | $IDENT_C$ |
|---|---|---|---|
| ☞ a. $ikus_1t_2en$ | | | * |
| b. $ikut_1s_2en$ | | | **! |

ii. //ut͡s+t͡sen// → [usten] 'leave' imperf. (failed evaluation)

| $u\widehat{ts}_1 + \widehat{ts}_2en$ | $OCP_{[strid]}$ | $OCP_{[–cont]}$ | $IDENT_C$ |
|---|---|---|---|
| ☹ a. $us_1t_2en$ | | | ** |
| b. $ut_1s_2en$ | | | ** |

In (13i), the ranking correctly predicts the attested output. The winner has one violation of the identity constraint, while candidate (13i-b) incurs two violations. The former changes only one input feature, i.e., the underlying affricate becomes non-strident; the latter, on the other hand, maps two features unfaithfully, i.e., the input //s// becomes [–continuant] and the input //t͡s// becomes [+continuant]. Conversely, there is no winner in (13ii) since both candidates violate $IDENT_C$ twice. The only difference between (13ii-a) and (13ii-b) is the location of the non-strident stop *vis-à-vis* the fricative: (13ii-a) contains a fricative+stop cluster and (13ii-b) contains a stop+fricative cluster. Importantly, the same problem concerns the nonlinear organization theory. This ranking paradox can be resolved by referring to a high-ranked markedness constraint prohibiting surface stop+continuant sequences, which are phonetically similar to segmental affricates. A constraint interacting with the proposed markedness constraint is, for instance, UNIFORMITY, which militates against coalescence (McCarthy & Prince 1995).

(14) NOAFFRICATECONTRAST (*AFFCON): Assign a violation mark for every sequence of [–continuant] + [+continuant] obstruents adjacent on the melodic tier whose members are linked to separate X-slots.
UNIFORMITY (UNIF): No coalescence.

Indeed, in Basque, words of the native stock exhibit no surface stop + fricative clusters. In addition to coronals, clusters *ks* and *ps* "are not allowed in Basque" (Hualde 1991:126); the only exceptions listed in Hualde (2003a:23) are borrowings: *seksu* 'sex' and *absolutu* 'absolute'.[11] Furthermore, the existence of a constraint militating against stop + fricative clusters finds its confirmation in Basque word-formation data and diachronic data. Sequences of /t/ followed by a fricative yield an affricate, e.g., *artzain* [ar͡tsain] from *ard(i)* + *zain* (Trask 2008:40).[12] It seems, then, that stop + fricative clusters are reanalyzed in Basque as single segments and that there is no phonological contrast between the two. These facts can be expressed in OT by the ranking NoAffricateContrast >> Uniformity, which assures that stop + fricative clusters surface as single segments.

Additional evidence for postulating NoAffricateContrast comes from Polish. In Standard Polish, there are minimal pairs that differentiate segmental affricates from stop + fricative sequences, e.g., [t͡ʃɨ] 'whether' *vs.* [tʃɨ] 'three'. However, in southern dialects, the distinction is frequently lost as stop + fricative clusters often become affricates (e.g., Dejna 1973:136 and 256 point 13d). This suggests that the constraint barring stop + continuant sequences is ranked crucially above Uniformity in these varieties and the reverse ranking, Uniformity >> NoAffricateContrast, is found in Standard Polish. Further support for NoAffricateContrast can be found in Puget Salish, where stop + fricative clusters formed by the addition of the third person possessive suffix /s/ to a stem ending in /t/ or /d/ become segmental affricates, e.g., /ʔəɬəd + s/ → [ʔəɬəd͡ʒ] 'food' (Hoard 1975:34).

The undominated position of NoAffricateContrast in (13) assures that candidate (13ii-b) loses to the attested output, (13ii-a), as shown in tableau (15).

(15)

| $u\widehat{ts}_1 + \widehat{ts}_2en$ | *AffCon | $OCP_{[strid]}$ | $OCP_{[-cont]}$ | $Ident_C$ |
|---|---|---|---|---|
| ☞ a. $us_1t_2en$ | | | | ** |
| b. $ut_1s_2en$ | *! | | | ** |

[11] In eastern dialects, any stop + fricative sequence can coalesce into an affricate, regardless of the original place of articulation, e.g., *etsemplu* 'example' from //ks// (Hualde 2003a:23). This fact contributes to the argumentation in favor of NoAffricateContrast.

[12] Depending on the view on phonology, some processes, especially word-formation processes, may be perceived as synchronic or diachronic. For instance, the adduced example, *artzain* 'shepard' from *ardi* 'sheep' and *–zain* 'guardian', may be claimed to be an output of an active morphological process (given that the suffix can be found in numerous nouns, e.g., *lemazain* 'helmsman' from *lema* 'helm, rudder' and the familiar *–zain*, and that the morphological make-up of the members of this paradigm is transparent) or to be a separate form with an independent underlying representation from its historical constituents. The point about the proposed constraint, however, stands regardless of the analysis we chose, since there is no contrast between affricates and stop + fricative clusters in Basque.

Both candidates violate the IDENT constraint twice. However, candidate (15b) loses due to a fatal violation of NOAFFRICATECONTRAST. This enables an analytical distinction between stop + fricative and fricative + stop clusters.

As demonstrated by the analysis in this section, both the strident stop approach and the nonlinear organization theory are possible solutions within the framework of OT. However, while the former does not raise any major formal issues, the latter requires the use of local constraint conjunction in order to account for the Basque data. Given the simplicity of representation and analysis within the simple segment approach, it should be considered superior to the complex segment approach.

# 4 Other processes

This section develops the ranking established in the previous section considering other processes in Basque phonology: the behavior of stop + stop clusters, coalescence of stop + fricative clusters and lenition of voiced obstruents. OCP can potentially play a significant role in these mappings and interact with other constraints responsible for the attested outputs. Consequently, the analysis of these processes verifies the proposed OCP-based approach.

## 4.1 Stop clusters

Consider the following data regarding stop deletion and affricate dissimilation found in word formation and fast speech (Hualde 1988b; examples from Hualde 1988b:380 and van de Weijer 1992:137).

| | | | | |
|---|---|---|---|---|
| (16) | a. | bat paratu | [p] | 'put one' |
| | | bat kurri | [k] | 'run one' |
| | | bat + naka | [n] | 'one by one' |
| | b. | hitz + tegi | [st] | 'dictionary' |
| | | haritz + ki | [sk] | 'oak wood' |
| | | haritz + mendi | [sm] | 'oak mountain' |

The data in (16a) show that clusters of two stops are simplified: a stop is deleted before another stop. As demonstrated by (16b), affricates are not deleted when followed by a non-continuant. Instead, they become [ + continuant] in the strident stop approach or the feature [–continuant] is delinked in the nonlinear organization approach. Hualde (1988b) sees the data in (16) as reflecting a single phonological process. The current OT analysis adheres to Hualde's line of reasoning in attributing these alternations to a single driver: similarity avoidance. Importantly, previous analyses of the data in (16) within rule-based frameworks led to a conclusion that affricates must be complex segments. This springs from the fact that there is no single rule that can account for both stop deletion in (16a) and affricate simplification in (16b) under the strident stop approach. Conversely, if affricates are seen as continuants and non-continuants at the same time, a rule that delinks the features of non-continuants (including the [–continuant] side of an affricate) before stops accounts for the whole process. This is no longer an issue in OT, where (16) can be generalized as reflecting a single phonological process without the necessity of postulating the nonlinear organization of affricates (see Archangeli & Pulleyblank 1987; Hualde 1988b for rule-based analyses).

Regardless of the assumed representation, the OT constraint responsible for the changes in (16) is $\text{OCP}_{[-\text{cont}]}$. In addition to the constraints discussed so far, we must refer to $\text{MAX}_{\text{SEG}}$, which prohibits segment deletion. The tableaux in (17) evaluate candidates for the inputs *bat paratu* ‘put one’ and *hitz + tegi* ‘dictionary’. For clarity, only the relevant segments are listed.

(17)

| i. bat paratu | $\text{OCP}_{[-\text{cont}]}$ | $\text{IDENT}_{\text{C}}$ | $\text{MAX}_{\text{SEG}}$ |
|---|---|---|---|
| a. tp | *! | | |
| b. sp | | *! | |
| ☞ c. p | | | * |

| ii. it͡s + teɣi | $\text{OCP}_{[-\text{cont}]}$ | $\text{IDENT}_{\text{C}}$ | $\text{MAX}_{\text{SEG}}$ |
|---|---|---|---|
| a. t͡st | *! | | |
| ☹ b. st | | *! | |
| ☜ c. t | | | * |

In (17i), the ranking yields the attested output, (17i-c). Candidate (17i-a) fatally violates the undominated OCP constraint, while candidate (17i-b) is eliminated due to its violation of a high-ranked faithfulness constraint, $\text{IDENT}_{\text{C}}$. The ranking in (17ii), on the other hand, is clearly problematic since the winner, (17ii-c), deletes a segment instead of rendering the affricate as a fricative. In fact, a similar problem is encountered in sequences of two affricates, as in (12), where the actual mapping under a low-ranked $\text{MAX}_{\text{SEG}}$ would yield an incorrect output, //ut͡s + t͡sen// → *[ut͡sen] ‘leave’. Tableau (18) repeats the evaluation from (12) and includes a deleting candidate. The nonlinear approach is not presented since it functions in parallel with the strident stop approach in this respect.

(18)

| ut͡s + t͡sen | $\text{OCP}_{[\text{strid}]}$ | $\text{OCP}_{[-\text{cont}]}$ | $\text{IDENT}_{\text{C}}$ | $\text{MAX}_{\text{SEG}}$ |
|---|---|---|---|---|
| a. ut͡st͡sen | *! | * | | |
| b. ut͡sten | | *! | * | |
| c. ust͡sen | *! | | * | |
| ☹ d. usten | | | *!* | |
| ☜ e. ut͡sen | | | | * |

Under such a ranking, the attested output, (18d), loses to candidate (18e); the former fatally violates IDENT$_C$, while the latter violates only low-ranked MAX$_{SEG}$.

In order to establish a new ranking, let us look at the generalizations discussed so far, which can be summarized as follows.

(19) a. Affricates can become fricatives, e.g., //i͡ts + teɣi// → [isteɣi] ‘dictionary’.
b. Affricates can become non-strident stops, e.g., //ikus + ͡tsen// → [ikusten] ‘see’.
c. Affricates are not deleted.
d. Non-strident stops never become strident.
e. Non-strident stops can be deleted, e.g., //bat paratu// → [ba paratu] ‘put one’.

Let us examine the facts in (19) in light of the strident stop approach. First, since affricates are free to become both fricatives, (19a), and non-strident stops, (19b), the input feature [–continuant] is allowed to change its value and the input [strident] can be delinked. Second, underlyingly non-strident segments cannot become [strident], (19d). Finally, only non-strident stops can be deleted, (19c) and (19e). In order to achieve such mappings, we need to split the IDENT$_C$ constraint into more specific directional constraints (cf. Pater 1999), given in (20).

(20) a. *Input-Output constraints*
MAX$_{[–cont]}$: Input [–continuant] must have its output correspondent.
MAX$_{[+cont]}$: Input [+continuant] must have its output correspondent.
MAX$_{[strid]}$: Input [strident] must have its output correspondent.
b. *Output-Input constraints*
DEP$_{[–cont]}$: Output [–continuant] must have its input correspondent.
DEP$_{[+cont]}$: Output [+continuant] must have its input correspondent.
DEP$_{[strid]}$: Output [strident] must have its input correspondent.

In order to satisfy (19a) and (19b), MAX$_{[–cont]}$ and MAX$_{[strid]}$ must be ranked low. DEP$_{[strid]}$, on the other hand, has to be undominated, as per (19d). Finally, in line with (19c) and (19e), MAX$_{SEG}$ must be ranked lower than DEP$_{[strid]}$ and OCP$_{[–cont]}$.

Equipped with a new set of constraints, let us return to the previously discussed generalizations. The evaluations of clusters //tt//, //͡tst//, //s͡ts// and //͡ts͡ts// are given in (21). We expect deletion in the first case and simplification to [st] in the remaining cases.

(21) *Strident stop*

| i. tt | OCP$_{[–cont]}$ | OCP$_{[strid]}$ | DEP$_{[strid]}$ | MAX$_{SEG}$ | MAX$_{[–cont]}$ | MAX$_{[strid]}$ |
|---|---|---|---|---|---|---|
| a. tt | *! | | | | | |
| ☞ b. t | | | | * | * | |
| c. st | | | *! | | * | |

| | ii. t͡st | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Dep$_{[strid]}$ | Max$_{SEG}$ | Max$_{[-cont]}$ | Max$_{[strid]}$ |
|---|---|---|---|---|---|---|---|
| | a. t͡st | *! | | | | | |
| ☞ | b. st | | | | | * | |
| | c. t | | | | *! | * | * |

| | iii. st͡s | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Dep$_{[strid]}$ | Max$_{SEG}$ | Max$_{[-cont]}$ | Max$_{[strid]}$ |
|---|---|---|---|---|---|---|---|
| | a. st͡s | | *! | | | | |
| ☞ | b. st | | | | | | * |
| | c. t͡s | | | | *! | | * |

| | iv. t͡st͡s | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Dep$_{[strid]}$ | Max$_{SEG}$ | Max$_{[-cont]}$ | Max$_{[strid]}$ |
|---|---|---|---|---|---|---|---|
| | a. t͡st͡s | *! | * | | | | |
| ☞ | b. st | | | | | * | * |
| | c. t͡s | | | | *! | * | * |

The ranking correctly selects the attested outputs. A high-ranked Dep$_{[strid]}$ guarantees that non-strident stops never become strident, as in (21i). Low-ranked Max$_{[-cont]}$ and Max$_{[strid]}$, on the other hand, allow affricates to mutate into fricatives or non-strident stops, which can be observed in (21ii), (21iii) and (21iv). Additionally, Max$_{SEG}$ is crucially ranked below Dep$_{[strid]}$ and OCP$_{[-cont]}$, but above Max$_{[-cont]}$ and Max$_{[strid]}$. In this way, only non-strident stops can be deleted.

In the nonlinear organization approach, the role of OCP$_{[strid]}$ is taken by the conjunction OCP$_{[+cont,\ +obstr]}$. Accordingly, Max/Dep$_{[strid]}$ are no longer present in the evaluation. The former is replaced by Max$_{[+cont]}$ and the latter by Dep$_{[+cont]}$.

(22) *Nonlinear organization*

| | i. tt | OCP$_{[-cont]}$ | OCP$_{[+cont,\ +obstr]}$ | Dep$_{[+cont]}$ | Max$_{SEG}$ | Max$_{[-cont]}$ | Max$_{[+cont]}$ |
|---|---|---|---|---|---|---|---|
| | a. tt | *! | | | | | |
| ☞ | b. t | | | | * | * | |
| | c. st | | | *! | | * | |

| | ii. t͡st | OCP$_{[-cont]}$ | OCP$_{[+cont,\ +obstr]}$ | Dep$_{[+cont]}$ | Max$_{SEG}$ | Max$_{[-cont]}$ | Max$_{[+cont]}$ |
|---|---|---|---|---|---|---|---|
| | a. t͡st | *! | | | | | |
| ☞ | b. st | | | | | * | |
| | c. t | | | | *! | * | * |

| iii. $\widehat{sts}$ | OCP$_{[-cont]}$ | OCP$_{[+cont,\ +obstr]}$ | DEP$_{[+cont]}$ | MAX$_{SEG}$ | MAX$_{[-cont]}$ | MAX$_{[+cont]}$ |
|---|---|---|---|---|---|---|
| a. $\widehat{sts}$ | | *! | | | | |
| ☞ b. st | | | | | | * |
| c. $\widehat{ts}$ | | | | *! | | * |

| iv. $\widehat{tsts}$ | OCP$_{[-cont]}$ | OCP$_{[+cont,\ +obstr]}$ | DEP$_{[+cont]}$ | MAX$_{SEG}$ | MAX$_{[-cont]}$ | MAX$_{[+cont]}$ |
|---|---|---|---|---|---|---|
| a. $\widehat{tsts}$ | *! | * | | | | |
| ☞ b. st | | | | | * | * |
| c. $\widehat{ts}$ | | | | *! | * | * |

As demonstrated in (22), the ranking yields the correct outputs. So far, the discussed representational theories do not differ substantially. Importantly, in contrast to earlier rule-based frameworks, OT does not provide arguments against the simple segment representation of affricates.

## 4.2 Coalescence

Let us return to the question of directionality. The data provided in the previous sections suggest that the grammar of Basque prefers fricative + stop outputs rather than the reverse. Furthermore, no coalescence can be found in the examples presented so far. Coalescence, however, must be considered in an analysis of the grammar of Basque. As already noted, affricates are single segments in Basque (Hualde 1991). Clusters of /t/ followed by a sibilant that result from concatenation become affricates (Trask 2008:40). Moreover, Hualde (2003a) reports that in the eastern dialects of Basque, sequences of a non-coronal stop followed by a sibilant are often rendered as affricates in borrowings. Additionally, in specific cases, similar mappings can occur even across morpheme or word boundaries, e.g., *onek zuen* → *onetzuen* 'this one had it' (Hualde 2003a:23). The presence of such processes in the language is also confirmed in Egurtzegi (2013:164), who provides a historical overview of mappings that can be dubbed *coalescence*.

> Clusters formed by a stop and a following prevocalic sibilant have usually yielded an affricate in composition: *artzain* < **ard(i)-zani* 'shepherd', *betzain* < **beh(i)-zani* 'cowherd', *betzain* < **beg(i)-zain* 'inner membrane of the eye', *otsein* < **og(i)-seni* 'servant', *betsein* < **beg(i)-seni* 'pupil' (apud *FHV*: 346). The examples above may only correspond to clusters involving a coronal stop, since all stops —and even the aspiration— became /t/ in the final position of the first member of a compound (cf. *beg(i)* 'eye' + *ile* 'hair' > *betile* 'eyelash', etc.). However, this process also affected loanwords which included clusters with a non-coronal stop followed by a sibilant, as in *atsolutu* (cf. Lat. *absolūtum*) 'absolute', *etsamina* (cf. Lat. *exāmen*) 'exam', *etsenplu* (cf. Lat. *exemplum*) 'example'. Egurtzegi (2013:164)

Historical data demonstrate more cases of coalescence in Basque. For instance, consider the behavior of nasal + stop clusters, reported by Egurtzegi (2013:165).

> Sequences of a nasal followed by a stop have sometimes been reduced to a single nasal, probably by assimilating the stop to the nasal (cf. **umbe* > *umme* —found in Lerga— > *ume* 'child' or *sembe* in Aquitanian anthroponyms > **semme* > *seme* 'son'). This process frequently affects labials, but is also found in alveolar clusters: *konbeni* > *komeni* 'to be appropriate, to be advisable', *konbentu* > *komentu* 'convent', *amizione* (cf. Lat. *ambitiōnem*) 'ambition', *gomitatu* (< Lat. *convitāre*) 'invite', *ganora, khanore* (< Lat. *candōrem*) 'skillfulness'. Egurtzegi (2013:165)

These data show that nasal + stop clusters underwent assimilation and simplification, which can be collapsed into coalescence in an output-oriented theory, such as OT. Interestingly, it seems that sequences of an alveolar nasal stop followed by a labial obstruent underwent pure coalescence, without the stage of assimilation (e.g., **konbeni* > *komeni* 'to be advisable'). Moreover, Egurtzegi (2013:164) reports as follows:

> For clusters of two stops, these have been consistently adapted to a single voiceless stop which shares its place of articulation with the etymologically prevocalic stop (see §4.4.2.2), as in the following compounds: *begi* 'eye': **bet-gain* > *bekain* and **bet-buru* > *bepuru* 'eyebrow', **bet-belar* > *bepelar* 'eyelash', etc. Egurtzegi (2013:164)

Egurtzegi attributes the choice of the target place of articulation to the fact that prevocalic stops have more perceptible cues than pre-consonantal stops (Ohala 1993). The process itself consists of voice assimilation and deletion, which can be interpreted as coalescence.

Considering the data indicating the possibility of coalescence in Basque, the analysis cannot overlook the candidates that include a fusion of segments. For instance, in the mapping //bat$_1$ p$_2$aratu// → [ba paratu] 'put one', there are two candidates that are phonetically identical but phonologically different, namely, [p$_2$] and [p$_{1,2}$]. The former deletes a segment and the latter coalesces two segments into one. Such a coalescence, however, can be problematic. The output [p$_{1,2}$] does not bear the distinctive features of both input segments, since the two segments are too similar. The input segments differ in only one element, which is the Place node. Therefore, on the surface, the coalesced output remains opaque and identical to deletion. Degemination is similarly problematic. The simplification of two identical segments into one may be interpreted as either deletion or coalescence. A transparent situation, on the other hand, consists of a merger of two segments that differ in (at least) two features, e.g., //bet$_1$ b$_2$uru// → [be p$_{1,2}$uru] 'eyebrow'. Here, the output segment [p] contains the two distinctive features of the input correspondents, i.e., the feature [–voice] from //t// and the Place node from //b//. For an overview of the *deletion vs. coalescence* issue, see Wheeler (2005).

In what follows, in addition to candidates that delete a segment, I consider coalescing candidates, e.g., //t$_1$p$_2$// → [p$_{1,2}$]. The details of the ranking are visible in (25), where candidates for the inputs //bat traban// ‘one stuck’, //art + sain// ‘shepherd’, //ut͡s + t͡sen// ‘leave’ (imperf.) and //ikus + t͡sen// ‘see’ (imperf.) are evaluated (the relevant segments only).[13] Crucially, Uniformity takes the position of Max$_{SEG}$ in the ranking and Max$_{SEG}$ is promoted to an undominated position. In effect, mappings previously dubbed deletion are treated phonologically as coalescence.[14] In the following evaluations, the nonlinear organization approach is omitted since it works in parallel with the strident stop approach.

(23) *Strident stops*

| | i. $t_1t_2$ | *AffCon | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Dep$_{[strid]}$ | Max$_{SEG}$ | Unif | Max$_{[-cont]}$ | Max$_{[strid]}$ |
|---|---|---|---|---|---|---|---|---|---|
| | a. $t_1t_2$ | | *! | | | | | | |
| ☞ | b. $t_{1,2}$ | | | | | | * | | |
| | c. $t_2$ | | | | | *! | | * | |
| | d. $s_1t_2$ | | | | *! | | | * | |

| | ii. $t_1s_2$ | *AffCon | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Dep$_{[strid]}$ | Max$_{SEG}$ | Unif | Max$_{[-cont]}$ | Max$_{[strid]}$ |
|---|---|---|---|---|---|---|---|---|---|
| | a. $t_1s_2$ | *! | | | | | | | |
| ☞ | b. t͡s$_{1,2}$ | | | | | | * | | |
| | c. $s_2$ | | | | | *! | | * | |
| | d. $s_1t_2$ | | | | *! | | | * | * |

| | iii. t͡s$_1$t͡s$_2$ | *AffCon | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Dep$_{[strid]}$ | Max$_{SEG}$ | Unif | Max$_{[-cont]}$ | Max$_{[strid]}$ |
|---|---|---|---|---|---|---|---|---|---|
| | a. $t_1s_2$ | *! | | | | | | * | * |
| ☞ | b. $s_1t_2$ | | | | | | | * | * |
| | c. t͡s$_{1,2}$ | | | | | | *! | | |
| | d. t͡s$_2$ | | | | | *! | | * | * |

| | iv. $s_1$t͡s$_2$ | *AffCon | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Dep$_{[strid]}$ | Max$_{SEG}$ | Unif | Max$_{[-cont]}$ | Max$_{[strid]}$ |
|---|---|---|---|---|---|---|---|---|---|
| | a. $s_1$t͡s$_2$ | | | *! | | | | | |
| ☞ | b. $s_1t_2$ | | | | | | | | * |
| | c. t͡s$_{1,2}$ | | | | | | *! | | |
| | d. t͡s$_2$ | | | | | *! | | | * |

13 In the tableaux that consider coalescence, I favor the prevocalic place of articulation, assuming a high-ranked faithfulness constraint that requires the identity of prevocalic features (Rubach 2008; for positional faithfulness in OT, see Beckman 1997; Casali 1997). Such an assumption is also justified from the perspective of phonetics. Prevocalic consonants have more salient phonetic cues than the pre-consonantal ones (Ohala 1993; Jun 2004).

14 Although this might seem as a complication, OT predicts that such a solution is perfectly acceptable, a fact that springs from Freedom of Analysis: “[t]he essential property of the Generator is that it is free to generate any conceivable output candidate for some input” (Kager 1999:20).

The ranking correctly selects the attested outputs. In (23i), candidate (23i-b) wins by coalescing two stops. Candidate (23i-a) is *hors de combat* for violating an undominated OCP constraint; (23i-c) fatally violates Max$_{\text{SEG}}$ and (23i-d) inserts the feature [strident], which is banned by high-ranked Dep$_{\text{[strid]}}$. In (23ii), coalescence is also preferred. Candidate (23ii-a) violates an undominated constraint NoAffricateContrast; (23ii-c) violates high-ranked Max$_{\text{SEG}}$ and, finally, (23ii-d) is rejected due to its insertion of stridency. In (23iii) and (23iv), on the other hand, fusion in candidates (23iii-c) and (23iv-c) is penalized by the ranking Uniformity > > Max$_{\text{[–cont]}}$, Max$_{\text{[strid]}}$. Candidate (23iii-a) fatally violates NoAffricateContrast, while (23iv-a) is eliminated based on its violation of OCP$_{\text{[strid]}}$. Finally, candidates (23iii-d) and (23iv-d) lose on Max$_{\text{SEG}}$.

There are at least two alternative approaches to the feature [strident] and the related faithfulness constraints. The first is to use the classic Ident constraint (e.g., Kager 1999) instead of positing Max/Dep$_{\text{[strid]}}$. In such a view, both the monovalent and the binary [strident] yield similar results. Accordingly, Ident$_{\text{[strid]}}$ (Id$_{\text{[strid]}}$) requires that the input segment and the corresponding output segment be identical with respect to the feature [strident]. This, however, creates a ranking paradox between the simplification of stop clusters and other OCP effects. Specifically, in order to prevent the mapping //tt// → *[st], Ident$_{\text{[strid]}}$ must be ranked higher than Uniformity, while in //$\widehat{ts}\widehat{ts}$// → [st] it must be ranked lower, as demonstrated by the tableaux in (24).

(24) *Strident stops – non-directional Ident constraints (failed evaluation)*

| i. $t_1t_2$ | *AffCon | OCP$_{\text{[–cont]}}$ | OCP$_{\text{[strid]}}$ | Max$_{\text{SEG}}$ | Id$_{\text{[strid]}}$ | Unif | Id$_{[\pm\text{cont}]}$ |
|---|---|---|---|---|---|---|---|
| a. $t_1t_2$ | | *! | | | | | |
| ☞ b. $t_{1,2}$ | | | | | | * | |
| c. $t_2$ | | | | *! | | | |
| d. $s_1t_2$ | | | | | *! | | * |

| ii. $t_1s_2$ | *AffCon | OCP$_{\text{[–cont]}}$ | OCP$_{\text{[strid]}}$ | Max$_{\text{SEG}}$ | Id$_{\text{[strid]}}$ | Unif | Id$_{[\pm\text{cont}]}$ |
|---|---|---|---|---|---|---|---|
| a. $t_1s_2$ | *! | | | | | | |
| ☞ b. $\widehat{ts}_{1,2}$ | | | | | * | * | * |
| c. $s_2$ | | | | *! | | | |
| d. $s_1t_2$ | | | | | **! | | ** |

| iii. $\widehat{ts}_1\widehat{ts}_2$ | *AffCon | OCP$_{\text{[–cont]}}$ | OCP$_{\text{[strid]}}$ | Max$_{\text{SEG}}$ | Id$_{\text{[strid]}}$ | Unif | Id$_{[\pm\text{cont}]}$ |
|---|---|---|---|---|---|---|---|
| a. $t_1s_2$ | *! | | | | * | | * |
| ☹ b. $s_1t_2$ | | | | | *! | | * |
| ☜ c. $\widehat{ts}_{1,2}$ | | | | | | * | |
| d. $\widehat{ts}_2$ | | | | *! | | | |

| iv. $s_1\widehat{ts}_2$ | *AFFCON | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | MAX$_{SEG}$ | ID$_{[strid]}$ | UNIF | ID$_{[\pm cont]}$ |
|---|---|---|---|---|---|---|---|
| a. $s_1\widehat{ts}_2$ | | | *! | | | | |
| ☹ b. $s_1t_2$ | | | | | *! | | |
| ☜ c. $\widehat{ts}_{1,2}$ | | | | | | * | * |
| d. $\widehat{ts}_2$ | | | | *! | | | |

The second possibility is to assume the directional Input→Output and Output→Input IDENT constraints (Pater 1999), given in (25).

(25) a. *Input-Output constraints*

IDENTINPUT-OUTPUT$_{[+strid]}$ (IDIO$_{[+strid]}$): Input [+strident] on a segment must be preserved in the output correspondent.

IDENTINPUT-OUTPUT$_{[-strid]}$ (IDIO$_{[-strid]}$): Input [–strident] on a segment must be preserved in the output correspondent.

b. *Output-Input constraints*

IDENTOUTPUT-INPUT$_{[+strid]}$ (IDOI$_{[+strid]}$): Output [+strident] on a segment must be present in the input correspondent.

IDENTOUTPUT-INPUT$_{[-strid]}$ (IDOI$_{[-strid]}$): Output [–strident] on a segment must be present in the input correspondent.

In such a scenario, IDENTOUTPUT-INPUT$_{[+strid]}$ >> UNIFORMITY allows for the simplification of stop clusters while UNIFORMITY >> IDENTINPUT-OUTPUT$_{[+strid]}$ prevents underlying affricates from coalescing. This ranking, however, runs into a paradox in the evaluation of stop + fricative clusters, which coalesce into affricates. For instance, //art + sain// → [ar$\widehat{ts}$ain] 'shepherd' is not possible under a high-ranked IDENTOUTPUT-INPUT$_{[+strid]}$ since the coalescing candidate that yields a surface affricate from the underlying //t + s// fatally violates this constraint. This paradox is demonstrated in (26). Importantly, regardless of whether [strident] is binary or privative, the results are similar since reference to [–strident] is not necessary.

(26) *Strident stops – directional IDENT constraints (failed evaluation)*

| i. $t_1t_2$ | *AFFCON | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | MAX$_{SEG}$ | IDOI$_{[+strid]}$ | UNIF | IDIO$_{[-cont]}$ | IDIO$_{[+strid]}$ |
|---|---|---|---|---|---|---|---|---|
| a. $t_1t_2$ | | *! | | | | | | |
| ☞ b. $t_{1,2}$ | | | | | | * | | |
| c. $t_2$ | | | | *! | | | | |
| d. $s_1t_2$ | | | | | *! | | * | |

| ii. $t_1s_2$ | *AffCon | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Max$_{SEG}$ | IdOI$_{[+strid]}$ | Unif | IdIO$_{[-cont]}$ | IdIO$_{[+strid]}$ |
|---|---|---|---|---|---|---|---|---|
| a. $t_1s_2$ | *! | | | | | | | |
| ☹ b. $\widehat{ts}_{1,2}$ | | | | | * | *! | | |
| c. $s_2$ | | | | *! | | | | |
| ☜ d. $s_1t_2$ | | | | | * | | * | * |

| iii. $\widehat{ts}_1\widehat{ts}_2$ | *AffCon | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Max$_{SEG}$ | IdOI$_{[+strid]}$ | Unif | IdIO$_{[-cont]}$ | IdIO$_{[+strid]}$ |
|---|---|---|---|---|---|---|---|---|
| a. $t_1s_2$ | *! | | | | | | * | * |
| ☞ b. $s_1t_2$ | | | | | | | * | * |
| c. $\widehat{ts}_{1,2}$ | | | | | | *! | | |
| d. $\widehat{ts}_2$ | | | | *! | | | | |

| iv. $s_1\widehat{ts}_2$ | *AffCon | OCP$_{[-cont]}$ | OCP$_{[strid]}$ | Max$_{SEG}$ | IdOI$_{[+strid]}$ | Unif | IdIO$_{[-cont]}$ | IdIO$_{[+strid]}$ |
|---|---|---|---|---|---|---|---|---|
| a. $s_1\widehat{ts}_2$ | | | *! | | | | | |
| ☞ b. $s_1t_2$ | | | | | | | | * |
| c. $\widehat{ts}_{1,2}$ | | | | | | *! | | |
| d. $\widehat{ts}_2$ | | | | *! | | | | |

The only solution to these paradoxes in classic OT is to posit the constraints Max/Dep$_{[strid]}$. Importantly, this solution works regardless of whether we assume a binary or a unary [strident]. The constraint Max$_{[strid]}$ works in a similar manner as IdentIO$_{[+strid]}$. Dep$_{[strid]}$, on the other hand, differs crucially from IdentOI$_{[+strid]}$ in that the former does not penalize spreading or coalescence. Therefore, Dep$_{[strid]}$ is not violated when a stop + fricative cluster coalesces into an affricate since the output feature [strident] has its input correspondent. This is not the case with the constraint IdentOI$_{[+strid]}$, which requires the presence of the feature [+strident] in the corresponding input segment. In a mapping such as $//t_1s_2// \rightarrow [\widehat{ts}_{1,2}]$, the output [+strident] stop corresponds to the input [–strident] stop, thus violating the identity constraint.

In classic feature-geometric representations (e.g., Clements & Hume 1995), end features tend to be represented as binary (e.g., [±voice]). The fact that [strident] is treated in the current discussion as a monovalent feature springs from the notion of natural classes. The assumption that the feature [±strident] is binary implies that [+strident] segments form a natural class to the same extent as [–strident] segments. Facing a lack of strong evidence in favor of this hypothesis, the null hypothesis should be to posit a privative [strident] since the reverse cannot be falsified.[15]

## 4.3 Lenition

The final process to be discussed is the behavior of voiced obstruents with respect to the feature [±continuant]. Consider the data in (27) (adapted from Hualde 1991:100).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (27) | a. | [aβere] | 'cattle' | [arβi] | 'turnip' | [dezβerðin] | 'uneven' |
| | | [aðar] | 'horn' | [arði] | 'sheep' | [ezðuin] | 'unworthy' |
| | | [laɣun] | 'friend' | [arɣi] | 'light' | [dezɣoɣo] | 'reluctance' |
| | b. | [embora] | 'trunk' | [beri] | 'new' | | |
| | | [mendi] | 'mountain' | [dore] | 'tower' | | |
| | | [aŋgo] | 'of there' | [gori] | 'red' | | |

The generalization drawn from these data can be formulated as follows: voiced obstruents are [+continuant] between [+continuant] segments and they are stops elsewhere. Importantly, (27a) shows that /r/ must be a [+continuant] segment since it patterns with other continuants. These facts can be formally analyzed as a spreading of the feature [+continuant] from the neighboring segments or as a spreading of the feature [–continuant] from the adjacent stops (and a pause). For instance, Hualde (1991) gives a rule-based account of this phenomenon and concludes that the most satisfactory (that is, the least problematic) approach is the spreading of [–continuant]. OT, however, handles the examples in (27) by means of a simple markedness constraint. A tentative constraint for obstruent lenition is given in (28). A constraint militating against the spreading of features is FillLink.

(28) Lenition (Len): Assign a violation mark for every voiced stop flanked from both sides by [+continuant] segments.
FillLink (FillL): Input association lines must be preserved in the output.

Let us first examine this process under the strident stop approach. The evaluation of candidates (the relevant segments) under the current ranking is given in tableau (29) for the inputs

[15] The problem with theories that assume that all features are binary is clearly explained in van der Hulst (2016:85): "[f]rom a methodological point of view, once the contrastive use of a phonetic parameter has been established, the initial hypothesis must be that one of its values is encoded in monovalent terms, implying that 'the other value' is a phonological nonentity (Kaye 1988). The monovalent hypothesis can be falsified by facts that require reference to the other pole. Such facts may lead to adopting 'the other pole' as the monovalent element or, if both poles need reference, to adopting two equipollent monovalent elements." The monovalent status of a feature is the default. Therefore, finding a process referencing the feature [–strident] at work would constitute evidence for a binary status of stridency.

//aDar// 'horn' and //ezDuin//[16] 'unworthy'. The input segments in question are voiced obstruents unspecified for continuancy, since there is no synchronic reason to treat them as either [+continuant] or [–continuant] (Hualde 1991).[17] Importantly, these segments are not strident.

(29) *Strident stop*

| i. aDar | LEN | $\text{OCP}_{[\text{strid}]}$ | $\text{DEP}_{[\text{strid}]}$ | $\text{MAX}_{\text{SEG}}$ | UNIF | FILLL |
|---|---|---|---|---|---|---|
| a. ada | *! | | | | | |
| ☞ b. aða | | | | | | * |
| c. aa | | | | *! | | |
| d. aza | | | *! | | | * |

| ii. $\text{ez}_1\text{D}_2\text{uin}$ | LEN | $\text{OCP}_{[\text{strid}]}$ | $\text{DEP}_{[\text{strid}]}$ | $\text{MAX}_{\text{SEG}}$ | UNIF | FILLL |
|---|---|---|---|---|---|---|
| a. $\text{z}_1\text{d}_2\text{u}$ | *! | | | | | |
| ☞ b. $\text{z}_1\text{ð}_2\text{u}$ | | | | | | * |
| c. $\text{z}_1\text{u}$ | | | | *! | | |
| d. $\text{z}_1\text{z}_2\text{u}$ | | *! | | | | * |
| e. $\text{z}_{1,2}\text{u}$ | | | | | *! | |

The ranking correctly predicts the victory of the attested outputs, (29i-b) and (29ii-b). In (29i), candidate (29i-d) inserts the feature [strident] and thus is rejected due to a violation of $\text{DEP}_{[\text{strid}]}$. Importantly, none of the candidates in (29i) violates the proposed OCP constraints since no consonantal cluster is involved. In (29ii), $\text{OCP}_{[\text{strid}]}$ is violated by candidate (29ii-d). Candidate (29ii-e), which coalesces two obstruents, is straightforwardly eliminated by UNIFORMITY. Candidates (29i-a) and (29ii-a) are excluded based on their violations of LENITION. $\text{DEP}_{[\text{strid}]}$ is not violated by candidate (29ii-d) since stridency is spread from the neighboring segment and hence is present in the input.

The situation becomes complicated when we assume the nonlinear organization approach. Consider the evaluations in (30), where $\text{OCP}_{[\text{strid}]}$ is replaced by the conjunction $\text{OCP}_{[+\text{cont}, +\text{obstr}]}$ and $\text{MAX/DEP}_{[\text{strid}]}$ are replaced by $\text{MAX/DEP}_{[+\text{cont}]}$.

[16] I do not discuss the issue of Fricative Voice Assimilation (fricatives become voiced before voiced consonants) and treat the input continuant as already voiced //z//.

[17] Under *Richness of the Base* (e.g., Kager 1999:19), the ranking should yield the correct output regardless of the underlying specification for continuancy on the segment in question. Indeed, the current ranking satisfies this requirement since both inputs //d// and //ð// yield the attested output. However, in the evaluations, the classic definition of UR is employed, which states that predictable features are not present underlyingly (see Rubach 2019).

(30) *Nonlinear organization (failed evaluation)*

| | i. aDar | Len | OCP$_{[+\text{cont}, +\text{obstr}]}$ | Dep$_{[+\text{cont}]}$ | Max$_{\text{SEG}}$ | Unif | FillL |
|---|---|---|---|---|---|---|---|
| | a. ada | *! | | | | | |
| ☹ | b. aða | | | | | | * |
| | c. aa | | | | *! | | |
| | d. aza | | | | | | * |

| | ii. $ez_1D_2uin$ | Len | OCP$_{[+\text{cont}, +\text{obstr}]}$ | Dep$_{[+\text{cont}]}$ | Max$_{\text{SEG}}$ | Unif | FillL |
|---|---|---|---|---|---|---|---|
| | a. $z_1d_2u$ | *! | | | | | |
| ☹ | b. $z_1ð_2u$ | | *! | | | | * |
| | c. $z_1u$ | | | | *! | | |
| | d. $z_1z_2u$ | | *! | | | | * |
| ☜ | e. $z_{1,2}u$ | | | | | * | |

The current ranking does not yield the correct outputs. In (30i), there is a tie between the desired (30i-b) and the unattested (30i-d). Both of them contain additional association lines that are not present in the input (they spread [+continuant]) and hence they both violate FillLink. Importantly, none of the candidates violates the constraint Dep$_{[+\text{cont}]}$ since this feature is present in the input. The attested output does not fare better in (30ii), where the coalescing candidate (30ii-e) wins. Importantly, none of the constraints used in (30) allows for a differentiation between the strident and the non-strident continuant. In other words, the feature [strident] must be included in the phonological description of Basque. Accordingly, in (31) Dep$_{[\text{strid}]}$ is used in an undominated position. Additionally, OCP$_{[+\text{cont}, +\text{obstr}]}$ is demoted below Max$_{\text{SEG}}$ and Uniformity.

(31) *Nonlinear organization (failed evaluation)*

| | i. aDar | Len | Dep$_{[\text{strid}]}$ | Dep$_{[+\text{cont}]}$ | Max$_{\text{SEG}}$ | Unif | OCP$_{[+\text{cont}, +\text{obstr}]}$ | FillL |
|---|---|---|---|---|---|---|---|---|
| | a. ada | *! | | | | | | |
| ☞ | b. aða | | | | | | | * |
| | c. aa | | | | *! | | | |
| | d. aza | | *! | | | | | * |

| | ii. $ez_1D_2uin$ | Len | Dep$_{[\text{strid}]}$ | Dep$_{[+\text{cont}]}$ | Max$_{\text{SEG}}$ | Unif | OCP$_{[+\text{cont}, +\text{obstr}]}$ | FillL |
|---|---|---|---|---|---|---|---|---|
| | a. $z_1d_2u$ | *! | | | | | | |
| ☹ | b. $z_1ð_2u$ | | | | | | * | * |
| | c. $z_1u$ | | | | *! | | | |
| | d. $z_1z_2u$ | | | | | | * | * |
| | e. $z_{1,2}u$ | | | | | *! | | |

The situation has improved since the attested output wins in evaluation (31i). However, the new ranking and the use of $\textsc{Dep}_{\text{[strid]}}$ does not salvage evaluation (31ii), which becomes a tie between (31ii-b) and (31ii-d). The latter candidate, even though containing a strident fricative, does not violate $\textsc{Dep}_{\text{[strid]}}$ since stridency is spread from the neighboring segment. The only solution is to posit a high-ranked $\text{OCP}_{\text{[strid]}}$ within the nonlinear organization approach.

(32) *Nonlinear organization*

| i. aDar | LEN | $\text{OCP}_{\text{[strid]}}$ | $\text{DEP}_{\text{[strid]}}$ | $\text{DEP}_{\text{[+cont]}}$ | $\text{MAX}_{\text{SEG}}$ | UNIF | $\text{OCP}_{\text{[+cont, +obstr]}}$ | FILLL |
|---|---|---|---|---|---|---|---|---|
| a. ada | *! | | | | | | | |
| ☞ b. aða | | | | | | | | * |
| c. aa | | | | | *! | | | |
| d. aza | | | *! | | | | | * |

| ii. $ez_1D_2uin$ | LEN | $\text{OCP}_{\text{[strid]}}$ | $\text{DEP}_{\text{[strid]}}$ | $\text{DEP}_{\text{[+cont]}}$ | $\text{MAX}_{\text{SEG}}$ | UNIF | $\text{OCP}_{\text{[+cont, +obstr]}}$ | FILLL |
|---|---|---|---|---|---|---|---|---|
| a. $z_1d_2u$ | *! | | | | | | | |
| ☞ b. $z_1ð_2u$ | | | | | | | * | * |
| c. $z_1u$ | | | | | *! | | | |
| d. $z_1z_2u$ | | *! | | | | | * | * |
| e. $z_{1,2}u$ | | | | | | *! | | |

The solution given in (32) is an unwelcome result since it renders the status of affricates once again unclear. If affricates are specified for both [+continuant] and [–continuant], the feature [strident] becomes non-contrastive for these segments and therefore should not be included in their representation. At the same time, it seems a superfluous complication to introduce additional mechanisms (such as complex segments) to account for data that are readily accounted for without these mechanisms.

As shown by the analysis in this section, the proposed OCP-based approach successfully accounts for the simplification of stop clusters and for the mutation of affricates. An important generalization allowed by the theory is that both of these processes can be attributed to the same driver, $\text{OCP}_{\text{[–cont]}}$, thus becoming readily analyzable as a single process. Moreover, the current ranking does not create any paradoxes when checked against coalescence and lenition. Finally, the constraint proposed in the previous section, NOAFFRICATECONTRAST, seems to be the correct driver for coalescence of stop + fricative clusters.

Regarding the theories of representation, it seems that the feature [strident] and the constraints referencing it cannot be readily discarded. Basque lenition shows that these elements must be included in the analysis regardless of the assumed approach. Consequently, it seems redundant to posit a more complicated representation of affricates since it does not offer any theoretical advantages. In other words, a simple-segment strident stop approach is sufficient to account for the data.

## 5 Nasals and OCP

The behavior of nasals in Basque presents a problem for the constraint $\text{OCP}_{[-\text{cont}]}$. Nasal stops, which are characterized as [–continuant], are commonly found before obstruent stops and affricates, contrary to what $\text{OCP}_{[-\text{cont}]}$ predicts. However, looking at the history of the language, we can observe a tendency for simplifying nasal + stop or nasal + nasal clusters. In such cases, the result of the simplification is a single nasal stop with the place of articulation of the original prevocalic segment (Egurtzegi 2013). This suggests that $\text{OCP}_{[-\text{cont}]}$ can potentially affect nasals. Importantly, in the modern language, affricates followed by nasals are not attested, similar to stops. This fact rules out a purely phonetic analysis. Unreleased stops have relatively weak phonetic cues and they are prone to simplification (Jun 2004). This, however, does not concern affricates, which are always released. Therefore, the prohibition of stop + nasal clusters cannot be driven only by the avoidance of unreleased stops. It is difficult to determine whether the discussed processes should be described in terms of phonology alone or in terms of both phonology and phonetics. It is entirely plausible that phonetics does play a role for non-strident stops. A purely phonetic analysis, however, fails to account for the facts concerning affricates. Therefore, regardless of whether phonetic explanations are accepted or not, phonological factors need to be admitted.

In order to salvage the OCP analysis, we need to consider the following conditions. The asymmetry between stop + nasal and nasal + stop clusters is due to two factors: (i) faithfulness to the feature [nasal] and (ii) nasal assimilation. The former is assured by an uncontroversial constraint $\text{I}{\small\text{DENT}}_{[\text{nasal}]}$ or $\text{M}{\small\text{AX}}_{[\text{nasal}]}$.[18] A high ranking of this constraint guarantees that nasality is never lost in consonantal clusters. The relevance of (ii) is explained below.

According to Hualde (1991:96), Basque nasals are not specified for Place features and they assimilate in the place of articulation to the following consonant. In his model, the Place node is spread from a consonant to the preceding nasal; crucially, the feature [ ± continuant] is not spread and nasals are underlyingly specified as [–continuant]. However, a more accurate account of nasal assimilation involves the spreading of not only the Place features, but also the feature [ ± continuant] (cf. Padgett 1991, who posits the spreading of the feature [–continuant] to nasals).

Nasal assimilation is a cross-linguistic phenomenon that can be found in a plethora of languages, including Basque (Hualde 1991), Polish (Rubach 1984), English (Baković 2007), Spanish (Harris 1967), Classical Arabic (Sa'aida 2020) or Kpelle (Welmers 1973). However, in

[18] I abstract away from whether the feature [nasal] is binary or privative (for discussion, see Clements *et. al* 2015).

order to establish if the feature [±continuant] can be spread to nasals, we need to examine a language where nasals can become [+continuant]. For this reason, let us look at Polish.

In Polish, nasals agree in the place of articulation with the following stop (Rubach 1984). While labial and coronal nasals can be found before vowels, as in (33a), velar nasals must be a product of assimilation.

| | | | |
|---|---|---|---|
| (33) | a. | [m]am | 'I have' |
| | | [n]am | 'to us' |
| | b. | a[mp]ułka | 'ampule' |
| | | A[nt]oni | 'Anthony' |
| | | ba[ŋk] | 'bank' |

The data in (33) attest for place assimilation, presenting no evidence for the assimilation of the feature [±continuant]. Nasal consonants may be underlyingly specified for the feature [–continuant] and no spreading of this feature is necessary. However, in Polish there is yet another assimilatory process concerning nasals, Nasal Gliding (Rubach 1984:134), whereby nasals assume the feature [+continuant] of the following fricative. Consider the formation of adjectives in the *–ski* paradigm (Rubach 1977:20).

| (34) | *Noun* | *Gen.sg.* | *Adjective* | *Gloss* |
|---|---|---|---|---|
| | Fi[n] | Fi[na] | fi[j̃s]ki | 'Finn' |
| | Londy[n] | Londy[nu] | londy[j̃s]ki | 'London' |
| | Szata[n] | Szata[na] | szata[j̃s]ki | 'Satan' |

The data in (34) show that the context of fricatives is crucial for the alternation. The nasal surfaces as [+continuant] before the fricative and as [–continuant] elsewhere. Additional evidence for the spreading of the feature [±continuant] onto nasals comes from the realization of Polish nasal vowels. On the surface, the nasal component must agree in the feature [±continuant] with the following obstruent, as demonstrated in (35) (Rubach 1977:1; Gussmann 2007:270–271).

| (35) | | *UR* | *Surface* | *Gloss* |
|---|---|---|---|---|
| | a. | //sɛNp// | [sɛmp][19] | 'vulture' |
| | | //pɛNd// | [pɛnt] | 'speed' |
| | | //mɛNka// | [mɛŋka] | 'torture' |
| | b. | //ʐɛNsa// | [ʐɛw̃sa] | 'eyelash' |
| | | //gɛNɕ// | [gɛj̃ɕ] | 'goose' |
| | | //vɛNx// | [vɛw̃x] | 'olfaction' |

[19] Since the nasality of the vowel is irrelevant for the present discussion, I omit this detail in the transcription. For details, see Rubach (1984).

It is not entirely clear what is the underlying representation (UR) of nasal vowels in Polish (cf. Rubach 1984; Gussmann 2007). In (35), regardless of the posited URs, the surface representations must conform to the nasal assimilation conspiracy. Accordingly, the nasals in (35) assume the feature [±continuant] of the following consonant: [–continuant] in (35a) and [+continuant] in (35b).[20]

Having established the possibility of the spreading of the feature [±continuant] from obstruents to nasals, let us examine Basque nasal assimilation. The data in (36) are adapted from Hualde (1991:96).

| | | | |
|---|---|---|---|
| (36) | a. | egu[m] berri | 'new day' |
| | | egu[n] denak | 'every day' |
| | | egu[ŋ] gorri | 'red day' |
| | b. | egu[ɱ] fresku | 'cool day' |

The data in (36a) show that Basque nasals assimilate to the place of articulation of the following stops. However, as attested by (36b), a nasal may become [+continuant] in the case of labials.[21] Therefore, similar to Polish, Basque nasal assimilation involves the spreading of the feature [±continuant]. The fact that this feature is not spread in case of other fricatives, such as [s], means that there must be a markedness restriction on [+continuant] nasals: [+continuant] coronal nasals are more marked than labiodental [+continuant] nasals. For instance, in English, words such as *i*[nf]*ormation*, where a nasal is followed by a labiodental fricative, develop a labiodental nasal [ɱ] in fast speech; however, words containing a nasal followed by a coronal fricative, such as *prince* [ns], never exhibit a coronal [+continuant] nasal. In OT, this relation can be expressed as a ranking: NoNasalFricativeCORONAL/DORSAL >> Agree$_{[\pm \mathrm{cont}]}$ >> NoNasalFricative (cf. Baković 2007 for the constraint NoNasalFricative).[22]

The Feature Geometric interpretation of nasal assimilation adequately accounts for the asymmetric behavior of nasals in Basque. In nasal + stop clusters, both segments share the feature [–continuant] and hence the OCP is not violated. In the reverse scenario, stop + nasal, the segments do not share any features; therefore, two adjacent non-continuants violate the OCP. Importantly, an analogous assimilatory process does not apply to obstruent stops. The phonetic facts, which find their reflection in language typology, indicate that nasals are more prone to assimilation than stops. In VCCV sequences, pre-consonantal nasals have less perceptible place cues than

[20] The spreading of the feature [±continuant] to nasals is also proposed in Hajek's (1991) account of Bolognese.

[21] The labiodental nasal [ɱ] is sometimes treated as [–continuant]. However, as pointed out in Ladefoged & Maddieson (1996:18), its phonetic status is unclear and the authors are not sure if "a true occlusive could be made with this gesture." For instance, Padgett (1991:125) treats it as "uncontroversially" [+continuant].

[22] Importantly, this constraint does not prohibit the spreading of Place features from fricatives to nasals. Therefore, as a reviewer points out, alternations such as *egun zoroa* 'crazy day' with alveolar [n] *vs. egun samina* 'bitter day' with prepalatal [ɲ̟] appear.

pre-consonantal stops and hence they are more likely to undergo assimilation (Jun 2004). In Feature Geometry, this relation can be expressed in terms of underspecification. Therefore, it is paramount that we assume the classic understanding of the UR, in which predictable features are not present underlyingly (Archangeli & Pulleyblank 1987; Archangeli 1988; Rubach 2019). Consequently, in a language exhibiting nasal assimilation, some nasals must be unspecified for a set of features. Specifically, these are the Place features (Hualde 1991) and the feature [±continuant] (cf. Padgett 1991).[23] Importantly, nasals that do not undergo assimilation must be specified for all features. Accordingly, word-final and pre-consonantal nasals are underspecified (as they are subject to nasal assimilation), but prevocalic nasals must contain a full underlying specification as their features are not predictable.

In OT, the constraint militating against archiphonemes is Spec (Prince & Smolensky 2004). As mentioned before, a high ranking of NoNasalFricative (Baković 2007) assures that nasals do not become [+continuant]. Finally, progressive assimilation is barred by a faithfulness constraint pertaining to association lines: ParseLink (ParseL) requires that all input association lines be preserved in the output (Itô *et al.* 1995:586). Importantly, if a segment is underlyingly unspecified for a given feature and links this feature from another segment on the surface, ParseLink is mute. In other words, ParseLink is unidirectional and functions as an Input→Output identity constraint. Its Output→Input correspondent is FillLink (FillL), which requires that surface association lines be present in the UR (see Pater 1999 for the directionality of constraints). For instance, //Nt// → [nt], where Place is shared by the two segments on the surface, does not violate ParseLink, since //N// is unspecified for Place and hence all input lines remain intact. Conversely, //tn// → [tn], where the two output segments share one Place node, violates ParseLink since both of them are specified for Place in the UR and hence not all lines are preserved in the output. In (37), the asymmetric behavior of nasals in consonantal clusters is presented. The relevant segments for *antolatu* 'organize' and *bat+naka* 'one by one' are evaluated.

(37)

| i. a$N_1t_2$olatu | Spec | ParseL | Max$_{[nasal]}$ | OCP$_{[-cont]}$ | Max$_{SEG}$ | Unif | FillL |
|---|---|---|---|---|---|---|---|
| ☞ a. $n_1t_2$<br>\ /<br>[–cont] | | | | | | | * |
| b. $n_1t_2$<br>[–cont] [–cont] | | | | *! | | | * |
| c. $n_{1,2}$ | | | | | | *! | |
| d. $t_{1,2}$ | | | *! | | | * | |
| e. $t_2$ | | | *! | | * | | |
| f. $N_1t_2$ | *! | | | | | | |

[23] A model that successfully represents the spreading of continuancy to nasals is proposed in, e.g., Clements & Hume (1995), where the feature [±continuant] is dependent of the Oral Cavity node (or Supralaryngeal node).

| ii. bat$_1$ n$_2$aka | SPEC | PARSEL | MAX$_{[nasal]}$ | OCP$_{[-cont]}$ | MAX$_{SEG}$ | UNIF | FILLL |
|---|---|---|---|---|---|---|---|
| a. t$_1$n$_2$<br>[–cont] | | *! | | | | | * |
| b. t$_1$n$_2$<br>[–cont] [–cont] | | | | *! | | | |
| ☞ c. n$_{1,2}$ | | | | | | * | |
| d. t$_{1,2}$ | | | *! | | | * | |
| e. n$_2$ | | | | | *! | | |

In (37i), the nasal and the obstruent in the optimal candidate, (37i-a), share the feature [–continuant] and hence do not violate OCP$_{[-cont]}$. In (37ii), on the other hand, coalescence is preferred. Since the nasal in (37ii) is prevocalic, it is underlyingly specified for all features. Therefore, candidate (37ii-a) fatally violates PARSELINK. This is not the case in (37i), where the nasal is underlyingly unspecified for continuancy.

## 6 Syllable-based analysis

As an alternative approach to the Basque data, let us briefly consider the syllable-based account proposed in Artiagoitia (1993). According to Artiagoitia (1993), Basque has a CCVC syllable template. The alternations presented in this paper, especially the simplification of stop clusters, are attributed to the constraints on the distribution of segments within the syllable. In particular, Basque Coda Condition prohibits non-strident obstruents in codas (Artiagoitia 1993:268); alternatively, non-continuant obstruents (Artiagoitia 1993, footnote 12). In this way, cases of consonant deletion in words such as [boskarren] 'fifth' from //bost + garren// are readily accounted for; coda stops remain unparsed and are thus subject to Stray Erasure. At the same time, word-final plosives are preserved due to an adjunction rule, e.g., *bost* [bost] 'five'. One problem with a syllable-based approach is that stops can be parsed into complex onsets word initially in Basque, e.g., *prest* [prest] 'ready'. Consequently, in order to prevent word-internal stop + C clusters, which can also be interpreted as complex onsets, a syllable-based analysis would have to posit additional language-specific constraints referring separately to word-initial and word-internal complex onsets (e.g., *no stops in word-internal complex onsets*).

In a similar manner, the restrictions on coda consonants, such as the Coda Condition proposed in Artiagoitia (1993), need to refer separately to word-internal and word-edge segments. Basque admits stops into codas and even into complex codas word-finally. Admittedly, Artiagoitia argues that word-final stops are parsed by a special adjunction rule. Depending on the theory, consonants can be adjoined directly to the syllable node or to the phonological word, bypassing the coda and hence not violating the Coda Condition. Nevertheless, an account based on the syllable structure employs additional mechanisms to distinguish between word-internal and word-edge stops, which seems an unnecessary complication when compared with the OCP approach. Even if the syllable-based account is descriptively adequate, it can miss a potential generalization concerning the dispreference for the adjacency of specific segments, such as *no stop clusters*, which does not directly spring from prosody.

In OT, a syllable-based account could refer to ANCHOR constraints (McCarthy & Prince 1995), which assure the faithfulness of edge segments. Therefore, a ranking CODACONDITION >> $\text{MAX}_{\text{SEG}}$ deletes all coda stops, while ANCHOR >> CODACONDITION preserves the stops at word edges. However, such a ranking predicts that edge stops are never deleted, which is counterfactual, e.g., *bat paratu* [ba paratu] 'put one'. The reverse ranking, CODACONDITION >> ANCHOR, on the other hand, bans any coda stops, which is also an undesired result, e.g., *bat* [bat] 'one'. In short, in classic OT, there is no straightforward ranking that would delete the final stop in *bat paratu* 'put one' and, at the same time, preserve the stop in *bat* 'one'.

## 7 Residual issue

One of the issues that remain unsolved by the current analysis is the behavior of the *n*-class verbs, that is, the verbs ending in *–n* in their perfective participle forms. Their historical development yielded a number of "puzzling peculiarities," as reported in Trask (1995:209). One of these peculiarities is demonstrated by the data in (38).

| | | | |
|---|---|---|---|
| (38) | *Perfect participle* | *Imperfective* | *Gloss* |
| | egin | egi + ten | 'do' |
| | jan | ja + ten | 'eat' |
| | entzun | entzu + ten | 'listen' |
| | esan | esa + ten | 'say' |
| | egon | ego + ten | 'be' |
| | eraman | erama + ten | 'carry' |

The data in (38) raise two questions. First, why does the final *n* alternate in the imperfective? Second, why does the suffix surface as *–ten*, instead of being the expected faithful *–tzen*? It seems that the change into a non-strident stop is gratuitous, since it does improve the well-formedness of the output.

The answer to the first question can be the following: *n* is a suffix and imperfectives are formed based on the root.[24] However, this is not a unanimous view. For instance, Hualde (2003b) analyzes the formation of imperfectives as an attachment of the suffix *–tzen* to the radical form,

[24] In actuality, most of the old verbs in Basque contain a prefix //e-// in their non-finite form, e.g., *egin* //e + gi + n// 'do'. Therefore, /e + gi/ is a stem rather than a root (Michelena 1990:64–65; Trask 1981:286).

stating that "[t]he suffixes -*tu* and -*i* are the only perfect participle suffixes" (Hualde 2003b:197). The radicals of the verbs in (38) are identical to their perfective participles given in the left-hand column; that is, *egin* 'do' is both the perfective participle and the radical (see Hualde 2003b:201–202). According to Hualde, the verbs in (38) undergo an *n*-deletion rule before the attachment of the imperfective suffix. This is problematic, given that there are other verbs that end with *n* in the radical but do not undergo *n*-deletion, e.g., *ken+du* 'remove', *ipin+i* 'put' (perf. participle) *vs. ken, ipin* (radical) *vs. ken+tzen, ipin+tzen* (imperf.). Therefore, the choice of the base for the imperfective formation seems unclear. The advantage of treating the final *n* in, e.g., *egin* 'do', as a suffix is that the algorithm of imperfective formation becomes similar for all verbal paradigms (cf. Ortiz de Urbina 1986).

One solution to the second question, why the imperfective –*tzen* is rendered as –*ten* in (38), might be to posit a modified version of *recoverability* (Kaye 1974). Recoverability explains the preference of opaque rule ordering over transparent rule ordering. A clear example of such a case can be found in Sea Dayak (McCarthy 1999:12): //naŋaʔ// 'straighten' surfaces as transparent [nãŋãʔ], with two nasalized vowels; //naŋgaʔ// 'set up a ladder', on the other hand, surfaces as opaque [nãŋaʔ], with one nasalized vowel. Although the form *[nãŋãʔ] in the second example would be transparent, it is avoided by the grammar. The reason is that if both //naŋaʔ// and //naŋgaʔ// were to yield transparent outputs, there would be no surface difference between them (without referring to other members of the paradigm); in other words, the difference would not be *recoverable*.

A variation of recoverability can be sought in Basque. If the imperfective suffix were to contain a transparent affricate in (38), the *n*-paradigm could not be distinguished from other verbal paradigms, specifically, from the –*tu* verbs and the vowel-final verbs. For instance, the two sets of transparent imperfective forms: (i) **egitzen*, **jatzen*, **esatzen* and (ii) *garbitzen*, *botatzen*, *erretzen*, would be analyzed equally with respect to their morphology. The forms in (i), therefore, take a mutated suffix in order to remain paradigmatically distinct. The arbitrariness of this pattern is not an issue, since it has been shown that even productive patterns need not be phonologically natural (e.g., Czaplicki 2013). However, a problem arising from such an explanation is that the grammar does not mind confusing other verbal paradigms: -*tu, -i* and zero-suffix groups take the same imperfective suffix –*tzen* (when not in violation of OCP), regardless of the phonological similarity of the roots. Both *jarr+i* and *agur+tu* take –*tzen*; similarly, *garbi+tu, jaiki* and *bota* (the three roots ending in a vowel). Therefore, the morphology of the derived *jar+tzen* and *agur+tzen* as well as *garbi+tzen, jaiki+tzen* and *bota+tzen* is not recoverable. A reason for such an asymmetry between paradigms can be sought in the frequency of the *n*-class verbs. The most frequently used Basque verbs (in perf. participle), according to the BasqueWaC v2 corpus available in Sketch Engine (Kilgarriff *et al.* 2014), are given in (39).

(39)

| Perfect participle | Frequency per million |
|---|---|
| *izan* 'be' | 4966 |
| *egin* 'do' | 3979 |
| *esan* 'say' | 1254 |
| *eman* 'give' | 1240 |
| *hartu* 'take' | 942 |
| *hasi* 'start' | 882 |
| *joan* 'go' | 738 |
| *ikusi* 'see' | 706 |
| *jarri* 'put' | 660 |
| *sortu* 'create' | 666 |
| *egon* 'be' | 598 |
| *jaso* 'receive' | 520 |

The data in (39) indicate that the *–n* verbs (underlined) constitute the most frequently used group of verbs in Basque. Frequency can be a significant factor in the anomalous behavior of forms (Bybee 2001). Therefore, the high frequency of the *–n* verbs can be an explanation for the discussed asymmetries between verbal paradigms.

## 8 Conclusions

It has been shown that the framework of Optimality Theory (OT) allows for a descriptively adequate account of Basque dissimilation effects within two theories of representation: the strident stop approach and the nonlinear organization of affricates. In the strident stop approach, the drivers of the presented mappings are similarity avoidance constraints $OCP_{[strid]}$ and $OCP_{[-cont]}$; the former prohibits two adjacent [strident] segments and the latter two adjacent [–continuant] segments. The nonlinear organization theory, in addition to the aforementioned OCP constraints, requires the use of $OCP_{[+cont]}$, which militates against adjacent [+continuant] segments, as well as $OCP_{[+obstr]}$, militating against adjacent obstruents. Crucially, the two constraints must work in a local conjunction $OCP_{[+cont]}\&OCP_{[+obstr]}$ in order to promote the attested outputs. These facts render the complex segment representation superfluous since the simple segment approach, which employs less theoretical machinery, readily handles the data. Specifically, the strident stop approach does not require the use of OT auxiliary theories, such as constraint conjunction. Moreover, the simple segment approach does not posit any special treatment of any features; conversely, the unordered organization theory proposes a special treatment of the feature [±continuant] as a segment can be specified for the two contradicting values of this feature. Finally, the feature [strident] and the corresponding constraints are required in the phonological description of Basque regardless of the assumed theory of representation. By Occam's razor, the strident stop approach is therefore preferred.

Another important issue raised in the analysis is the directionality of the changes. Basque avoids stop + fricative outputs, for instance, [st] is favored over *[ts]. An explanation of this asymmetry can be found in a high-ranked markedness constraint, NoAffricateContrast, that prohibits stop + fricative sequences on the surface. Languages that contrast true affricates, which are single segments, with stop + fricative clusters must rank NoAffricateContrast low.

A potential problem for the OCP analysis of the Basque data can be found in the behavior of nasals, which do not participate in the dissimilation pattern. Specifically, they seem to be immune to the constraint $OCP_{[-cont]}$. This fact finds its explanation in the feature geometric interpretation of nasal assimilation, whereby nasals share both the Place features and the feature [±continuant] with adjacent stops. For instance, in a sequence [nt], the nasal crucially shares the feature [–continuant] with the following stop. In this way, OCP is not violated and the attested output wins the evaluation.

An analysis rooted in the syllable structure seems less satisfactory than the OCP-based approach since it creates additional theoretical problems pertaining to the distinction between word-internal and word-edge segments. In particular, stops are not allowed in word-internal codas and complex onsets, while they are permitted at word edges. Since the simplification of stop clusters functions across morpheme and word boundaries, these problems are not straightforwardly resolved in classic OT, where a ranking paradox between Anchor and CodaCondition arises.

Finally, the irregular and phonologically unjustified behavior of the *n*-class verbs in Basque finds no explanation in the OCP analysis. One solution is to posit a modified version of recoverability, in which opaque patterns are preferred by the grammar. This preference is driven by the fact that if the opaque output is not selected, the contrast between underlying forms is lost on the surface. Such a phenomenon is not found in other verbal paradigms in Basque. However, the anomalous behavior of the *n*-verbs might be attributed to their high frequency of use.

Although there seem to be no consensus regarding the representation of affricates, the amassing research on this topic points to the theoretical advantages of the strident stop approach. Admittedly, the Basque data can be analyzed within the nonlinear organization theory; however, this theory no longer offers analytical advantages over the simple segment approach. In contrast to rule-based theories, OT allows for the simple segment representation in Basque without the loss of important generalizations.

## Abbreviations

[cont] = [continuant], [obstr] = [obstruent], [strid] = [strident], imperf. = imperfective, perf. = perfective

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## Competing Interests

The author has no competing interests to declare.

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