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Item Type	article;article
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Download date	2024-12-04 09:41:42
Link to Item	https://hdl.handle.net/20.500.14394/36954

Edge Effects and the Prosodic Hierarchy: Evidence from Stops and Affricates in Basque

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1. Introduction¹

Stem-final consonants are often subject to alternations that depend on the following context. Typical cases are found in Diola Fogany (1) and French (2). Final consonants appear unchanged in word-final position (1, 2a) and before vowel-initial suffixes (1b, 2c), but delete (1) or trigger epenthesis (2b) before consonant-initial suffixes.

- (1) Deletion in Diola Fogany (Itô 1986):
- | | | |
|---------------------|-----------------|---------------|
| a. /na-yoken-yoken/ | → [nayokeyoken] | 'he tires' |
| b. /-tey-tey-or/ | → [tetyor] | 'disentangle' |
- (2) Epenthesis in French:
- | | | |
|---------------|--------------|-----------|
| a. /trist/ | → [trist] | 'sad' |
| b. /trist-mã/ | → [tristœmã] | 'sadly' |
| c. /trist-es/ | → [tristes] | 'sadness' |

A traditional account of these patterns (e.g. Itô 1986) involves two mechanisms: 1. extraprosodicity or extrametricality, and 2. resyllabification into the onset of the following syllable. Consonants may be licensed by the syllabification rules of the language or by virtue of their extraprosodic status at a word edge. If neither mechanism is available, which may be the case in word-internal preconsonantal contexts, a repair strategy must be adopted, typically deletion or epenthesis.

My aim in this paper is twofold. First, I show that edge effects at the word level are only a subcase of edge effects at the end of all prosodic constituents, from the word to the utterance. These edge effects also become stronger as we move up the Prosodic Hierarchy, i.e. the higher the prosodic boundary, the more consonants it licenses. Second, I develop a phonetically-motivated approach to these edge effects, which crucially relies on the perceptual cues to consonants and the phonetic characteristics of edges of prosodic domains. This account is cast in Optimality Theory, specifically in the 'licensing by cue' approach of Steriade (1997). It is characterized by the absence of a syllabic level, which

¹Thanks to Ikuska Ansola for being such a good informant, and to José Ignacio Hualde for insightful comments on the data and the relevant literature. Thanks also to Karlos Arregi, Ken Hale, Yoonjung Kang, Michael Kenstowicz, and Cheryl Zoll.

allows us to dispense with both extraprosodicity and resyllabification.² It also accounts for the (previously unnoticed) special status of stops with respect to edge effects.

Evidence for this approach is taken primarily from new data I have collected from the Ondarroa Basque dialect (Northern Biscayan variety). I focus on morpheme- and word-final stops and affricates, which have been dealt with in a number of recent papers (see below). The analysis I propose for the behavior of stops and affricates in Basque departs significantly from previous approaches, which could not account for some aspects of the Ondarroa data (as well as data from other dialects).

2. Final stops and affricates in (Ondarroa) Basque

Basque displays a well-known process that deletes stem- or word-final stops³ and simplifies affricates⁴ before a consonant, in morphological as well as certain syntactic contexts ("+" indicates a word-internal morpheme boundary):

- (3) a. /ot^ɕ bat/ → [oɕpat] 'a cold'
 b. /ot^ɕ+tu/ → [oɕtu] 'to get cold'
- (4) a. /bat paratu/ → [bapratu] 'put one'
 b. /laket+tu/ → [laketu] 'to be pleased'
 (Salaburu 1984, Saltarelli 1988, Hualde 1991, Kim 1997)

This process has been amply discussed in the literature, especially in relation to the featural structure of affricates (see e.g. Hualde 1987, 1988, 1991; Lombardi 1990; van de Weijer 1992; Kim 1997). According to the description given in these works, the deletion / simplification process is triggered by a following [-continuant] consonant, but blocked in case a fricative follows:

- (5) /ederak çineten/ → [ederakçineten] / *[ederaçineten] 'you.PL were beautiful'
 (Salaburu 1984)

The process is viewed as an OCP effect on the [continuant] tier; it suppresses sequences of [-continuant] consonants by deleting stops and removing the [-continuant] part of affricates (which are assumed to be both [-continuant] and [+continuant]).

This analysis is largely based on the dialect spoken in Baztan (although this is not always explicitly mentioned). There is, however, a great deal of dialectal variation in various aspects of this phenomenon. The data provided in many other dialectal descriptions call for a revision of the analysis of stop deletion and affricate simplification, which should be viewed as part of a more general process of avoidance of consonants, in particular stops and affricates, in non-prevocalic position. The following observations have to be made, which are illustrated below with data from the Ondarroa dialect:

²This should also be seen as a positive result to the extent that resyllabification appears problematic from an empirical point of view, as shown by Labov (1997).

³Of the stops /p,t,k,b,d,g/ (+c,j/ in many dialects), only /t,k/ appear morpheme-finally.

⁴Many Basque dialects have three affricates and their corresponding fricatives, as detailed below:

(i)	<u>Point of articulation</u>	Apico-alveolar	Predorso-alveolar	Palato-alveolar
	<u>Phonemic transcription</u>	/s/ - /t ^s /	/ç/ - /t ^ç /	/ʃ/ - /t ^ʃ /
	<u>Orthography</u>	<s> - <ts>	<ç> - <tç>	<x> - <tx>

In all Biscayan (including Ondarroa) and some Guipuscoan varieties, the contrast between apico-alveolar and dorso-alveolar fricatives and affricates has been lost. The unique non-palatal coronal fricative in Ondarroa is [s], whereas the corresponding affricate is [t^s]. However, I represent both sounds by /s/ and /t^s/, without indicating the articulatory distinction between the affricate and the fricative.

- Alongside deletion/simplification, some dialects use other strategies to prevent consonants from surfacing in certain contexts. Epenthesis is used in Getxo (Hualde & Bilbao 1992), Arratia (Etxebarria Ayesta 1991), and Ondarroa. Merger of stop-fricative sequences into affricates is used in Souletin (Hualde 1993) and Baztan (N'Diaye 1970; Salaburu 1984).
- Deletion and epenthesis are used before all consonants, including [+continuant] ones, in many dialects, e.g. Lekeitio (Hualde, Elordieta & Elordieta 1994), Arratia (Etxebarria Ayesta 1991), Getxo (Hualde & Bilbao 1992), and Ondarroa (Rotaetxe 1978).
- Epenthesis is used with consonants other than stops and affricates in Getxo (Hualde & Bilbao 1992) and Ondarroa.
- The preconsonantal context is not accurate, as epenthesis may also be used at the pause in Arratia (Etxebarria Ayesta 1991) and Ondarroa. This suggests that the relevant context for deletion, simplification and epenthesis should be defined as non-prevocalic.

2.1. Prevocalic position

No change takes place when morpheme-final stops and affricates are followed by a vowel-initial suffix or word. This is illustrated in (6)-(7) for Ondarroa Basque, in word-internal contexts (6) and across word boundaries (7).^{5,6}

- (6) Stops and affricates before suffixes
- | | | |
|------------------------------|----------------------------|--------------------|
| a. /kokot+an/ | → [kokotan] | 'neck+GENITIVE.SG' |
| b. /aberat ^s +en/ | → [aberat ^s en] | 'rich+SUPERLATIVE' |
- (7) Stops and affricates across word boundaries
- | | | |
|--------------------------------------|---|-----------------------------|
| a. /pijo bat isot ^s / | → [pijobatisot ^s] | 'a lot of ice' |
| | pile one ice.ABS.IND | |
| b. /basu-k erosi t ^{us} / | → [basukerosit ^{us}] | 's/he has bought glasses' |
| | glass-ABS.PL buy.PERF AUX.3SGS.3PLD | |
| c. /iru t ^{ikot} erosi dot/ | → [irut ^{ikoterosirot}] | 'I have bought three ropes' |
| | three rope.ABS.IND buy.PERF AUX.1SGS.3SGD | |
| d. /eskat ^s andi bat/ | → [eskat ^s andibat] | 'a/one big kitchen' |
| | kitchen big one.ABS | |

2.2. Deletion, simplification, and epenthesis in non-prevocalic position

When no vowel follows, various repair strategies are available to prevent stops and affricates from surfacing in non-prevocalic position. In Ondarroa, stop deletion, affricate simplification, and epenthesis are used. The choice between these strategies depends on the category of the lexical item. Nouns and adjectives must be distinguished from other categories, which include⁷:

⁵I use the following abbreviations for glosses:

- ABS	absolutive	- SG	singular	- AUX	auxiliary	- S	subject
- ERG	ergative	- PL	plural	- PERF	perfective participle		
- PROL	prolative	- DEF	definite	- 1/2/3	first/second/third person		
- DIM	diminutive	- IND	indefinite	- D	direct object		

⁶In Basque, as in Spanish, voiced stops [b, d, g] have spirantized allophones [β, ð, γ]. I disregard this allophony in the data, using only the symbols for voiced stops.

⁷I do not consider non-synthetic verbs (i.e. the vast majority of verbs). These always appear in one of their participial forms, accompanied by an auxiliary. All participles end in a vowel or /n/ (not an obstruent), and are mostly irrelevant to the present study. The rules that govern the formation of these participial forms (by adding participial suffixes to the stem) are relevant, as verbal stems may end in a stop or affricate. But this would require a separate study, which I will not undertake here. It is already clear, however, that adding verbs to our data set would not alter the conclusions of this investigation, as the same basic principles are operative in verbal and nominal morphology (see Hualde, Elordieta & Elordieta 1994 for a description of the verbal morphology in Lekeitio Basque, a dialect very close to Ondarroa).

- numerals / determiners / quantifiers (*bat* 'one, a', *bost* 'five', *semat* 'how much/many')
- some auxiliaries and synthetic verbal forms (*dot* 'AUX.1SGS.3SGD', *dakat* 'I have')
- some inflectional suffixes (ergative /-k/, absolutive plural /-ak/, ablative /-tik/), which can be added to nouns, adjectives, pronouns, and determiners.

Final affricates only appear in nouns or adjectives, whereas all the categories have words ending in a stop. With nouns and adjectives, stop deletion is ruled out; only epenthesis and simplification are available. With other categories, only deletion is used (simplification is irrelevant). This is illustrated in (8)-(10) below (deletion, simplification or epenthesis are obligatory word-internally but optional across word boundaries; we will get back to that distinction in the next section).

- (8) Stops in nouns and adjectives: epenthesis
- | | | |
|--------------------------|---|-----------------------------|
| a. /kokot+tʃo/ | → [kokotatʃo] | 'neck+DIM' |
| b. /tʃalet+tʃat/ | → [tʃaletatʃat] | 'chalet+PROL' |
| c. /kokot bat/ | → [kokot(a)bat] | 'a/one neck' |
| d. /iru kiʃket bota dot/ | → [irukiʃket(a)botarot] | 'I have thrown three locks' |
| | three lock.ABS.IND throw.PERF AUX.1SGS.3SGD | |
- (9) Affricates in nouns and adjectives: epenthesis or simplification
- | | | |
|----------------------------|---|-------------------|
| a. /sotʃ+tʃo/ | → [sotʃatʃo] / [sostʃo] | 'toothpick+DIM' |
| b. /latʃ+tu/ | → [latʃetu] / [lastu] | 'to become rough' |
| c. /motʃ+tu/ | → *[motʃitʃu] / [mostu] | 'to shorten' |
| d. /oratʃ+tʃo/ | → [oratʃatʃo] / ??[orastʃo] | 'comb+DIM' |
| e. /eskatʃ bat/ | → [eskatʃ(a)bat] / [eskabʃat] | 'a/one kitchen' |
| f. /lau biʃotʃ meresi dot/ | → [laubiʃotʃ(a)meresirot] / [laubiʃosmeresirot] | |
| | four heart.ABS.IND deserve AUX.1SGS.3SGD | |
| | 'I have deserved four hearts' | |
- (10) Stops in other categories: deletion
- | | | |
|------------------------|---------------------------------|--------------------------------|
| a. /semat mutil/ | → [sema(t)mutil] | 'how many boys' |
| b. /giʃon-ak topa dau/ | → [giʃona(k)toparau] | 'the man has found it/him/her' |
| | man-ERG find.PERF AUX.3SGS.3SGD | |

The epenthesis of [a] actually deserves a special mention, because [a] is not a purely phonological epenthetic vowel but corresponds to an empty definite absolutive suffix. Most Basque dialects oppose definite and indefinite forms of nouns and adjectives in all cases, but this distinction is maintained only in the absolutive case in Ondarroa, the indefinite form being identical to the bare form, the definite one containing an additional final [a] (for stems ending in a consonant). For example, the uninflected and absolutive indefinite form of /kokot/ 'neck' is [kokot], its absolutive definite form [kokota] (see Hualde 1995 for a more complete inflectional paradigm in Ondarroa Basque). But even in the absolutive case the distinction between the indefinite and definite forms has weakened to the point where the definite one is used in contexts that normally require the uninflected or indefinite form (e.g. with quantifiers and numerals). [a] is deprived of its definite meaning and the [a]-final forms are analyzed as variants of uninflected/indefinite forms used for phonological reasons, to avoid sequences of consonants that would result from the use of the consonant-final uninflected or indefinite form.^{8,9}

⁸See Hualde & Bilbao (1992) and Côté (1998) for more on the opacity of the definite/indefinite distinction in Getxo and Ondarroa, and the contexts that require the use of the uninflected, indefinite and definite forms.

⁹The epenthesis of [a] can be distinguished from that of [e]. [e] can be considered a 'true' epenthetic vowel, which is inserted between all consonant-final nominal and adjectival stems and consonant-initial inflectional markers, with the exception of prolativ /-tʃat/. This kind of epenthesis used in inflectional morphology is irrelevant for our purposes since it does not distinguish stops and affricates from other consonants.

Deletion, simplification, and epenthesis take place before any consonant, including [+continuant] ones, which argues against an OCP-based account of the behavior of stops and affricates.¹⁰ Examples of stop deletion before all types of consonants are given in (11).

- | | | | | |
|------|-------------|--|-----------------------|---------------------------|
| (11) | Stops: | a. /ore-k paper-ak/ | → [ore(k)paperak] | 'those papers' |
| | Affricates: | b. /semat tʃakur/ | → [sema(t)tʃakur] | 'how many dogs' |
| | Nasals: | c. /gison bat mima dau/ | → [gijomba(t)mimacau] | 'he has mimed a man' |
| | | man one.ABS mime.PERF AUX.3SGS.3SGD | | |
| | Laterals: | d. /gu-k lortu dou/ | → [gu(k)lorturou] | 'we have gotten it' |
| | | we-ERG get.PERF AUX.1PLS.3SGD | | |
| | Fricatives: | e. /ore-k sagusar-ak/ | → [ore(k)sagusarak] | 'those bats' |
| | | f. /semat xeneral/ | → [sema(t)xeneral] | 'how many generals' |
| | | g. /gu-k fiʃa ga/ | → [gu(k)fiʃaga] | 'we have trusted' |
| | | we-ERG trust.PERF AUX.1PLS | | |
| | Rhotics: | h. /semat radiʃo/ | → [sema(t)radiʃo] | 'how many radios' |
| | | i. /gu-k rosa dou/ | → [gu(k)rosarou] | 'we have gotten together' |
| | | we-ERG get together.PERF AUX.1PLS.3SGD | | |

Only stops and affricates are subject to deletion and simplification, but epenthesis of /a/ is possible with other consonants, although it is never obligatory word-internally (12a-e), and more marginal than with stops and affricates across word boundaries (12f). Interestingly, the use of /a/ in word-internal contexts seems to be linked to the sonority of the stem-final consonant: the less sonorous it is, the more likely it is for /a/ to be used. Stems ending in /t/ are incompatible with the vocalic marker (12a), those ending in a nasal accept both the forms with direct addition of the suffix and insertion of /a/ (12b), those ending in a fricative slightly favor the use of the vowel (12c-e).

- | | | | |
|------|--------------------|------------------------------------|-------------------|
| (12) | a. /atʰamar+tʰat/ | → [atʰamartʰat] / *[atʰamaratʰat] | 'finger+PROL' |
| | b. /gison+tʰat/ | → [gisonatʰat] / [gisonatʰat] | 'man+PROL' |
| | c. /frantʰes+tʰat/ | → ?[frantʰestʰat] / frantʰesatʰat | 'Frenchman+PROL' |
| | d. /lanbas+tʰo/ | → (?) [lanbasʰo] / [lanbasatʰo] | 'mop+DIM' |
| | e. /ames+tʰo/ | → (?) [amesʰo] / [amesatʰo] | 'dream+DIM' |
| | f. /frantʰes bat/ | → [frantʰesbat] / ??[frantʰesabat] | 'a/one Frenchman' |

This suggests that there is a general tendency to avoid consonants in non-prevocalic position, a tendency that seems to depend on the sonority level of the consonant and is strongest with stops and affricates. An analysis of the Ondarroa data should account for the general tendency as well as the distinction among consonants. As a simplifying assumption, I group together all the consonants other than stops and affricates, and

¹⁰We can go back to the data in (5) and ask why the Baztan dialect does not delete stops before fricatives. It must first be noted that the generalization that stops do not delete before [+continuant] consonants in Baztan is based only on coronal fricatives. Data involving non-coronal fricatives /f,x/ and rhotics are missing (in part because these segments are marginal (word-initially) in Basque). Evidence for the OCP account is therefore quite limited, and the different behavior of stops before coronal fricatives is amenable to another explanation, related to the possibility of merging stop-coronal fricative sequences into the affricate corresponding to the fricative. This process is completely productive in the Souletin dialect (Hualde 1993, based on Larrasquet 1928). So both /-t S-/ and /-k S-/ become /tʰS-/ (with S being one of the three coronal fricatives), e.g. *húak sáa* → *húatʰsáa* 'weed those'. In Baztan, the merging process generally applies only with /t/; with /k/ it is restricted to pronoun-verb sequences, as in */onek ɟuen/* → *[onetʰuen]* 'this one had it' (Salaburu 1984), /k/ remaining intact in other syntactic contexts, e.g. in */ederak ɟineten/* in (5). But it is plausible that affrication with /k/ used to be more general in Baztan, as evidenced by the different output given for the same example by older informants in N'Diaye (1970): */ederak ɟineten/* → *[ederatʰineten]*. How the present Baztan pattern should be analyzed is not entirely clear, however, especially in the absence of data with non-coronal fricatives and rhotics.

consider epenthesis to be optional word-internally and marginal across word boundaries.

2.3. The role of the Prosodic Hierarchy

It has been noted that epenthesis or simplification with stops and affricates is obligatory word-internally but optional across word boundaries, without further qualifications. I now further investigate the role of the prosodic context in the behavior of final consonants.

The generalization that emerges from the Ondarroa data is that the likelihood of the use of a repair strategy - deletion, simplification, or epenthesis - decreases with the strength of the prosodic boundary, if any, that follows the consonant. In other words, consonants are more easily licensed as we go up the Prosodic Hierarchy. For the sake of explicitness, I adopt the following simple hierarchy: Prosodic Word (PW) - Phonological Phrase (PP) - Intonational Phrase (IP) - Utterance (U) (see Inkelas & Zec 1995 and the references cited therein). I also assume, following Selkirk (1986), Zec (1988), and Inkelas (1989), that prosodic units below the word belong to a different hierarchy.

Let us see in detail the situation for final stops and affricates. No stops or affricates are allowed in non-prevocalic position word-internally, that is if no prosodic boundary follows. (Word-internal contexts are relevant only for nouns and adjectives, followed by a derivational or inflectional suffix.) So epenthesis is always used when stop-final nominal stems are followed by consonant-initial suffixes, as shown in (13).¹¹

- | | | | |
|------|------------------|-----------------|-------------------------|
| (13) | a. /kiʃket+tʰat/ | → [kiʃketatʰat] | 'lock+PROL' |
| | b. /galant+tʰat/ | → [galantatʰat] | 'elegant / robust+PROL' |
| | c. /kokot+tʰo/ | → [kokotatʰo] | 'neck+DIM' |
| | d. /tʰalet+sale/ | → [tʰaletasale] | 'fond of chalets' |

Epenthesis is the preferred option with affricate-final stems, but simplification is also possible, depending on lexical factors that are unclear. In any case, affricates do not remain intact in this context. With *-ʰat*, epenthesis is largely preferred with all lexical items (14); with *-tʰo* and *-sale*, it is always fully grammatical, while the acceptability of the forms involving simplification depends on the lexical item (15). With the verbalizing suffix *-tu*, usually only one form is good, although both epenthesis and simplification are acceptable in (16a-b). (Here the epenthetic vowel is /e/ or /i/, /tʰ/ palatalizing into [tʰ] when the latter is used.) Which form is to be preferred does not seem to be predictable from the shape of the stem, cf. the contrast between *mostu* (16c) and *oʰʰitʰu* (16g).

- | | | | |
|------|------------------|---------------------------------|------------------|
| (14) | a. /arotʰ+tʰat/ | → [arotʰatʰat] | 'carpenter+PROL' |
| | b. /eskatʰ+tʰat/ | → [eskatʰatʰat] | 'kitchen+PROL' |
| | c. /bijotʰ+tʰat/ | → [bijotʰatʰat] | 'lamb+PROL' |
| (15) | a. /lapitʰ+tʰo/ | → [lapitʰatʰo] / [lapistʰo] | 'pencil+DIM' |
| | b. /sotʰ+tʰo/ | → [sotʰatʰo] / [sostʰo] | 'toothpick+DIM' |
| | c. /aritʰ+tʰo/ | → [aritʰatʰo] / (?) [aristʰo] | 'oak tree+DIM' |
| | d. /otʰ+tʰo/ | → [otʰatʰo] / ??[ostʰo] | 'cold+DIM' |
| | e. /eskatʰ+tʰo/ | → [eskatʰatʰo] / ??[eskastʰo] | 'kitchen+DIM' |
| | f. /aberatʰ+tʰo/ | → [aberatʰatʰo] / ??[aberastʰo] | 'old+DIM' |

¹¹Very few suffixes (other than the inflectional ones that trigger 'true' epenthesis with all consonant-final stems; see note 9) are productive enough to be freely associated with a reasonable number of stems ending in affricates and stops. The most productive ones are prolativ *-ʰat* and the diminutive suffix *-tʰo*. Also useful is the adjectival suffix *-sale* 'fond of'. The verbalizing suffix *-tu* appears in a large number of items, but its synchronic productivity is limited.

	g. /gilt ^s +tʃo/	→ [gilt ^s atʃo] / *[gilt ^s tʃo]	'key+DIM'
	h. /irunt ^s +tʃo/	→ [irunt ^s atʃo] / *[irunt ^s tʃo]	'dew+DIM'
	i. /gat ^s +sale/	→ [gat ^s asale] / *[ga(s)sale]	'fond of salt'
	j. /leat ^s +sale/	→ [leat ^s asale] / [lea(s)sale]	'fond of hake'
(16)	a. /aberat ^s +tu/	→ [aberat ^s itʃu] / [aberastu]	'to become rich'
	b. /lat ^s +tu/	→ [lat ^s etu] / [lastu]	'to become rough'
	c. /mot ^s +tu/	→ *[mot ^s itʃu] / [mostu]	'to shorten'
	d. /sorrot ^s +tu/	→ *[sorrot ^s itʃu] / [sorostu]	'to sharpen'
	e. /garat ^s +tu/	→ *[garat ^s itʃu] / [garastu]	'to become sour'
	f. /balt ^s +tu/	→ [balt ^s itʃu] / *[balstu]	'to blacken'
	g. /ot ^s +tu/	→ [ot ^s itʃu] / *[ostu]	'to get cold'

Stops and affricates are allowed to surface in non-prevocalic position when followed by some prosodic boundary (i.e. in word-final position). But not all word-final positions are equivalent. As a first approximation, we can oppose phrase-internal (word-final) stops / affricates and utterance-final ones. In phrase-internal contexts, e.g. within DPs or object-verb sequences, stops may delete and affricates may simplify. But these processes are only optional and epenthesis may also take place. So we get two possibilities with stops, three with affricates, as illustrated in various syntactic contexts in (17)-(19).¹²

- (17) Phrase-internal stops in nouns / adjectives: retention, epenthesis
- | | | |
|--------------------------|---|-----------------------------|
| a. /kokot bat/ | → [kokot(a)bat] | 'a/one neck' |
| b. /iru kiʃket dakat/ | → [kiʃketdakat] / [kiʃketarakat] | 'I have three locks' |
| | three lock.ABS.IND I-have | |
| c. /iru kiʃket bota dot/ | → [irukiʃket(a)botarot] | 'I have thrown three locks' |
| | three lock.ABS.IND throw.PERF AUX.1SGS.3SGD | |
- (18) Phrase-internal affricates in nouns / adjectives: retention, simplification, epenthesis
- | | | |
|--|--|-----------------|
| a. /eskat ^s bat/ | → [eskat ^s (a)bat] / [eskasbat] | 'a/one kitchen' |
| b. /lau biʃot ^s meresi dot/ | → [laubiʃot ^s (a)meresirot] / [laubifosmeresirot] | |
| | four heart.ABS.IND deserve.PERF AUX.1SGS.3SGD | |
| | 'I have deserved four hearts' | |
| c. /iru lapit ^s topa dot/ | → [irulapit ^s (a)toparot] / [irulapistoparot] | |
| | three pencil.ABS.IND find.PERF AUX.1SGS.3SGD | |
| | 'I have found three pencils' | |
- (19) Phrase-internal stops in other categories: retention, deletion
- | | | |
|---------------------------|--------------------------------------|----------------------|
| a. /semat batel/ | → [sema(t)batel] | 'how many boats' |
| b. /liburu bat galdu dot/ | → [liburuba(t)galdurot] | 'I have lost a book' |
| | book one.ABS lose.PERF AUX.1SGS.3SGD | |
| c. /ore-k sagusara-k/ | → [ore(k)sagusarak] | 'those bats' |

Utterance-finally, stops and affricates never delete nor simplify. The use of /a/-epenthesis is possible, but marginal and less acceptable than in word- and phrase-internal contexts. This is shown in (20)-(21):

- (20) Utterance-final stops/affricates in nouns/adjectives: retention, epenthesis marginal
- | | | |
|------------------------------|---|--------------|
| a. /lau kokot/ | → [laukokot] / ?? [laukokota] | 'four necks' |
| b. /bost okot ^s / | → [bostokot ^s] / ?? [bostokot ^s a] | 'five chins' |
- (21) Utterance-final stops in other categories: retention only
- | | | |
|------------|-------------------|-----------------------|
| a. /semat/ | → [semat] *[sema] | 'how much / how many' |
|------------|-------------------|-----------------------|

¹²Epenthesis and simplification are associated with faster speech and/or more colloquial registers.

- b. /liburu bat/ → [liburubat] *[liburuba] 'one/a book'
 c. /iru orat^s erosi dot/ → [iruorat^serosirot] *[iruorat^serosiro]
 three comb.ABS.IND buy.PERF AUX.1SGS.3SGD
 'I have bought three combs'
 d. /ore-k umi-k/ → [orekumik] *[orekumi] 'those children'

The relevant factor for mandatory stop/affricate retention, however, is not the presence of a following pause, or the utterance-final position. Utterance-internal stops and affricates at the right edge of dislocated or fronted constituents behave just like utterance-final ones. Compare (22a), in which the object has been fronted, with (22b), which uses the neutral SOV order, with stops in other categories. (23) illustrates the behavior of stops and affricates in nouns and adjectives at the end of fronted constituents.

- (22) Stops in other categories at the end of dislocated constituents: retention
 a. /prak-ak gifon-ak erosi dau/ → [prakakgifonakerosirau] *[prakagifo...]
 pants-ABS.PL man-ERG.SG buy.PERF AUX.3SGS.3SGD
 'pants, the man has bought'
 b. /gifon-ak prak-ak erosi dau/ → [gifona(k)prakakerosirau]
 man-ERG.SG pants-ABS.PL buy.PERF AUX.3SGS.3SGD
 'the man has bought pants'
- (23) Stops/affricates in nouns/adjectives at the end of fronted constituents:
 retention, epenthesis marginal
 a. /lau ki^sket gifon-ak erosi dau/ → [lauki^sket(??a)gifonakerosirau]
 four lock.ABS.IND man.ERG.SG buy.PERF AUX.3SGS.3SG.D
 'four locks, the man has bought'
 b. /lau lapit^s gifon-ak erosi dau/ → [laulapit^s(??a)gifonakerosirau]
 four pencil.ABS.IND man.ERG.SG buy.PERF AUX.3SGS.3SG.D
 'four pencils, the man has bought'

Dislocated elements are not necessarily separated by a phonetic pause from the rest of the sentence. Although the claim is often made that dislocation is characterized by the presence of a pause, more careful phonetic studies always indicate that this is not the case (see e.g. Barnes 1985 and Dupont 1985 for French). What does characterize dislocation, however, is the presence of a strong prosodic boundary between the dislocated element and the rest of the sentence. This boundary can be identified as delimiting intonational phrases.

So the behavior of word-final stops/affricates is determined by their position within IPs. IP-final stops and affricates cannot delete or simplify; /a/-epenthesis in this context is marginal. In contrast, IP-internal word-final stops and affricates combine the possibilities of word-internal and IP-final positions: stops and affricates are allowed in preconsonantal position, but all the repair strategies - deletion, simplification, and epenthesis - are also available.

As for consonants other than stops, they never delete, but we have seen that nouns and adjectives trigger epenthesis optionally word-internally and marginally word-finally. The table in (24) summarizes the main facts about the behavior of final consonants in various prosodic contexts. It can clearly be seen that these consonants are licensed more and more easily as we go up the Prosodic Hierarchy, and that the repair strategies available to prevent them from surfacing in non-prevocalic position are used less and less.¹³

¹³The effect of the Prosodic Hierarchy on the licensing of final consonants can be seen in other languages. See Côté (1999) for epenthesis in French and stop deletion in Marais Vendéen (Oïl dialect).

(24)	Word-internal (no boundary)	Word-final (PW or PP boundary)	IP-final (IP boundary)
Stops and affricates			
Stops/affricates allowed?	no	yes	yes
Repair strategy?	obligatory	optional	marginal
Stop deletion	N/A	yes	no
Affricate simplification	?yes	yes	no
/a/-epenthesis	yes	yes	??yes
Other consonants			
Other consonants allowed?	yes	yes	yes
Repair strategy?	optional	marginal	
Epenthesis	yes	??yes	
Deletion	no	no	

3. Analysis

3.1. General proposal

I summarize in (25) the empirical generalizations that emerge from the Ondarroa Basque data and which the proposed analysis accounts for.

- (25) a. Consonants want to appear before a vowel;
 b. Stops are more disfavored than other consonants in non-prevocalic position;
 c. The retention of non-prevocalic consonants correlates with the strength of the following prosodic boundary.

All three generalizations can be related to well-known phonetic properties of consonants and domain-final positions, which I use as the basic motivation for a series of perceptually-based constraints. These constraints adopt the general schema in (26), which rules out elements in contexts where they are perceptually weak, i.e. where the cues to the recoverability of that element by listeners are relatively poor. This type of constraints is used in particular by Steriade (1997) in her 'licensing by cue' approach:

- (26) *X / Y: Do not have X (feature or segment) in a context Y in which X is perceptually weak

The generalization in (25a) is associated directly with the constraint in (27).

- (27) *C / __ → V Do not have a consonant not followed by a vowel

The motivation behind the constraint in (27) lies in the phonetic characteristics of consonants. The identification of consonants relies on a number of acoustic cues, which can be divided into three categories: contextual cues (especially formant transitions from and to adjacent vowels), internal cues (present in the production of the consonant itself), and, for stops only, the release burst (see Wright 1996 for a summary of available cues to consonants' place and manner of articulation). There is, however, a significant difference between VC and CV transitions, the former being mediocre and much weaker than the latter for most consonants (retroflexes are exceptional in this respect, cf. Steriade 1997). Consonants are identified much more rapidly with CV cues than VC ones (Warner 1999). So, everything else being equal, consonants have better contextual cues in prevocalic than in postvocalic position. Related to this is the fact that consonants are less precisely articulated in post- than in prevocalic position (Sussman et al. 1997). The relative weakness of postvocalic transitions certainly constitutes the main factor involved in the

general preference for consonants to appear in onset rather than in coda position.

But not all consonants suffer equally from missing prevocalic transitions. The quality of the non-contextual cues - internal cues and release bursts - also plays a role. It appears that stops and affricates are particularly at a disadvantage, for two main reasons. These segments involve a complete closure in the oral cavity, with no nasal airflow. This part of the segment is silent (apart from vocal folds vibration in voiced consonants) and provide very weak (internal) cues. The non-contextual cues of stops and affricates are rather concentrated in their release, but the release burst is often absent or weakly audible in non-prevocalic position. By contrast, nasals, fricatives, and liquids all have relatively strong internal cues.

We have seen that in Basque, consonant deletion/simplification and epenthesis specifically target stops and affricates. The same applies in epenthesis and deletion in a variety of languages (Côté 1997, 1999). The distinction between stops/affricates and other consonants with respect to the quality of their internal cues motivates the constraint in (28a), which is a sub-case of (27) that applies specifically to stops (and affricates). I assume that (28a) universally dominates the more general constraint (27), since it is a necessary property of stops that they suffer more than other consonants from not appearing in prevocalic position.

- (28) a. *[-son,-cont]/__→V Do not have a stop not followed by a vowel
 b. *[-son,-cont]/__→V >> *C/_→V

The ranking in (28b) accounts for the generalization in (25b). What about (25c)? How and why should the Prosodic Hierarchy be integrated into these phonotactic or markedness constraints? The licensing of consonants depends on the presence and nature of the immediately following prosodic boundary; this is accounted for by introducing in the constraints in (27) and (28a) a variable that refers to prosodic boundaries, as in (29a-b). The ranking in (29c) follows from that in (28b).

- (29) a. *C/_]i→V Do not have a consonant not followed by a vowel
 across a boundary i
 b. *[-son, -cont]/_]i→V Do not have a stop not followed by a vowel across a
 boundary i
 c. *[-son, -cont]/_]i→V >> *C/_]i→V

Since higher prosodic boundaries license consonants more easily than lower ones (the lowest being the null one, or the absence of a boundary), we can establish the rankings in (30), generalized to (31), which actually define a family of constraints against non-prevocalic consonants, based on the relative weakness of contextual cues in this position.

- (30) a. *C/_]∅→V >> *C/_]PW→V >> *C/_]PP→V >> *C/_]IP→V >> *C/_]U→V
 b. *[-cont,-son]/_]∅→V >> *[-cont,-son]/_]PW→V >>
 *[-cont,-son]/_]PP→V >> *[-cont,-son]/_]IP→V >> *[-cont,-son]/_]U→V
- (31) a. *C/_]i→V >> *C/_]j→V
 b. *[-cont, -son]/_]i→V >> *[-cont, -son]/_]j→V
 where $i, j \in \{\emptyset, PW, \dots, IP, U\}$ ($i = \emptyset \rightarrow$ word-internal)
 i is lower in the prosodic hierarchy than j

There is a clear phonetic motivation for the hierarchy in (31), which relies on the processes that are reported to occur at the end of various prosodic constituents, from the word to the utterance: lengthening, strengthening, and a reduced degree of overlap with the

following segment. The studies that confirm domain-final lengthening are numerous, e.g. Oller (1973), Klatt (1975), Cooper & Danly (1981), Beckman and Edwards (1990), Wightman et al. (1992). Fougeron & Keating (1997) have attested the presence of articulatory strengthening in the same position for vowels, but similar results have to be obtained for consonants.

These phonetic correlates of domain-final positions - lengthening, strengthening, and less overlap - all conspire to license more segments and more complex segments: a strengthened and lengthened articulation correlates with more robust auditory cues, and those cues are not susceptible to weakening through overlap with a following segment. Stops and affricates particularly benefit from those effects, which facilitate the production of more strongly released bursts. The phonetic characteristics of stops in IP-internal and IP-final position in Basque are consistent with the general approach adopted here, since the former are consistently unreleased or reduced to a glottal articulation, whereas the latter are quite systematically strongly released.

It is also well established that the lengthening, strengthening, and overlap effects get stronger as we move from the word to the utterance. Consequently, the right edge of higher prosodic domains is a stronger licenser than the right edge of lower domains. This fact motivates the assumption of the universality of the ranking in (31).¹⁴ Segments in word-internal position are not followed by any (relevant) prosodic boundary. Therefore they do not benefit at all from the advantages associated with domain-final positions, i.e. lengthening, strengthening, and reduced overlap. This explains why stops and affricates are completely banned word-internally in preconsonantal position in Basque.

3.2. Specific analysis of Ondarroa Basque

With this general proposal in hand, we are ready for a more specific analysis of the Ondarroa Basque data. The constraints against non-prevocalic consonants form the backbone of the analysis. These constraints interact with some standard faithfulness constraints to determine what repair strategy, if any, is adopted in a given context.

Three prosodic contexts have been identified for final consonants: word-internal (i.e. null boundary), IP-internal (i.e. PW and PP boundary), and IP-final (i.e. IP boundary). We therefore need the two sets of constraints in (32), one for stops and affricates, and one for consonants in general.

- (32) a. $*C/ _] \emptyset \neg V \gg *C/ _]_{PW/PP} \neg V^{15} \gg *C/ _]_{IP} \neg V$
 b. $*[-son, -cont]/ _] \emptyset \neg V \gg *[-son, -cont]/ _]_{PW/PP} \neg V \gg *[-son, -cont]/ _]_{IP} \neg V$

These constraints interact with those in (33), which deal with the various repair strategies available: deletion (33a), simplification (33b), and /a/-epenthesis (33c). Two distinct constraints against deletion are actually necessary, since nouns and adjectives behave differently from other categories in this respect. To account for the greater stability

¹⁴The universality of the ranking in (31) predicts that languages cannot allow more complex consonant clusters phrase-finally than phrase-internally (everything else being equal). This prediction constitutes the most crucial distinction between my and Wiltshire's (1998) approach. Wiltshire suggests that phrasal effects of the sort investigated here should be accounted for by allowing alignment constraints to refer to higher prosodic constituents. She claims that constraints on phrase-final boundaries can be more highly ranked than constraints on word boundaries, and brings Tamil as an example for such a ranking. Tamil allows coda consonants phrase-medially but not phrase-finally. But phrase-internal codas are all homorganic with the following onset (geminate and homorganic sonorants). This obligatory dependency makes Tamil an unconvincing case.

¹⁵I will omit PP from the formulation of the constraints $*[-son, -cont]/ _]_{PW/PP} \neg V$ and $*C/ _]_{PW/PP} \neg V$.

of stops in nouns, I assume, with Smith (1997), that a faithfulness constraint specific to nouns (MAX-N) dominates the general one (MAX). I also assume that affricate simplification violates IDENT-[cont], since the [+continuant] specification of the affricate is lost in the fricativization process.

- (33) a. Constraints against deletion:
 MAX: Do not delete segments
 MAX-N: Do not delete segments in nouns (including adjectives) (Smith 1997)
 MAX-N >> MAX
- b. Constraint against affricate simplification
 IDENT-[cont]: Corresponding segments in the input and output must bear the same specification for the feature [continuant]
- c. Constraint against /a/-epenthesis:
 DEP-/a/: No epenthesis of a proxy definite marker /a/ in nouns
 (i.e. in contexts where the definite form is not normally used)

What remains to be determined is the ranking of these constraints that yields all and only the data attested in Ondarroa Basque. One complication comes from the substantial amount of variation and, to a certain extent, gradient well-formedness in the behavior of consonants and the choice of the repair strategy. The integration of variation and gradient well-formedness into phonological theory has always been a difficult (and mostly unaddressed) issue, but it has recently been revived within Optimality Theory, which seems to offer new avenues to deal with these problems (see e.g. Reynolds 1994, Anttila 1997, Hayes in press, Boersma & Hayes 1999).

The variation present in the system cannot be handled by the standard approach to OT, in which all constraints are ranked with respect to each other. The addition of constraint ties does not solve the problem, as the same constraints would have to be tied with other constraints that are strictly ranked with respect to each other, a situation that is logically impossible, unless we adopt floating constraints, like Reynolds (1994). One viable approach is developed by Anttila (1997), who proposes that grammars are partial orders, in which constraint rankings may remain undetermined. Any grammar may then be compatible with many complete rankings. These distinct rankings may, in turn, yield different outputs. This is how variation is generated by the system (grammar). It is this view of grammars as partial orders that I adopt here to account for the data.¹⁶

To the rankings in (32) and (33a) we can add those in (34), deduced from (29c).

- (34) a. *[-son,-cont]/___]∅→V >> *C/___]∅→V
 b. *[-son,-cont]/___]PW→V >> *C/___]PW→V
 c. *[-son,-cont]/___]P→V >> *C/___]P→V

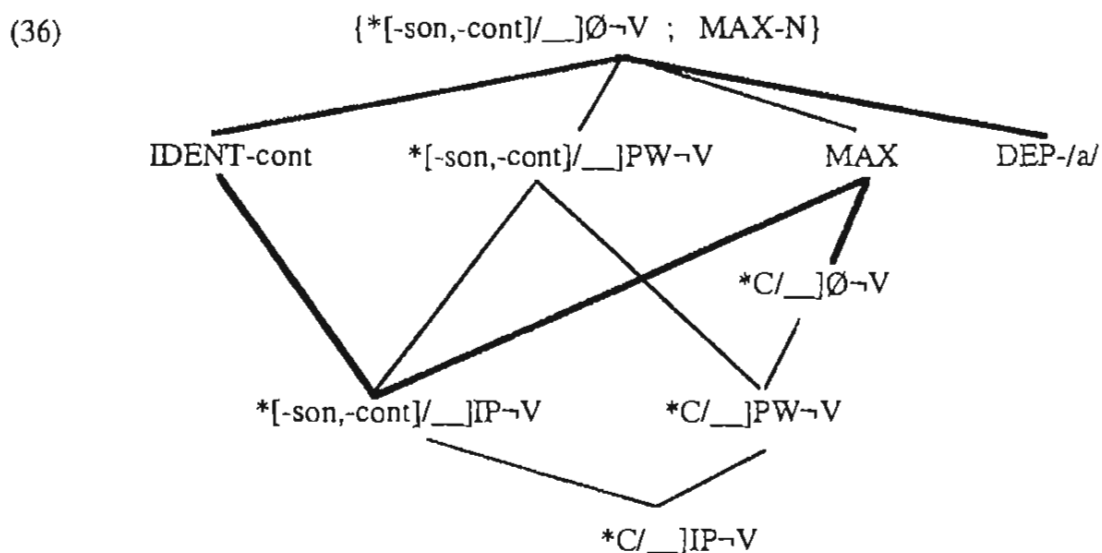
The following additional rankings can be established on the basis of the data summarized in (24). I assume that constraints that are never violated on the surface are undominated (Tesar & Smolensky 1993, Tranel 1995).

- (35) a. Pre-consonantal stops/affricates never appear word-internally:
 → *[-son,-cont]/___]∅→V is unviolated, therefore undominated.
 b. Consonants in nouns never delete:
 → MAX-N is unviolated, therefore undominated.

¹⁶Another idea of grammars viewed as partial orders is that frequency of use and relative well-formedness judgments of a given output should reflect the probability that it be generated by the grammar, that is the proportion of the possible rankings that yields this output. I do not address this issue here; see Anttila (1997) and Côté (1998) for an application to Ondarroa Basque.

- c. Deletion of consonants other than stops is ruled out:
 → MAX >> *C/___]Ø→V
- d. Affricate simplification and stop deletion in non-nominal categories are ruled out IP-finally:
 → MAX >> *[-son,-cont]/___]IP→V
 → IDENT-[cont] >> *[-son,-cont]/___]IP→V

We obtain the grammar in (36) (dark lines indicate rankings determined by data, light lines indicate fixed universal rankings). This partial grammar generates, through its multiple possible rankings, all the possible outputs, and no others (see 24). For example, the optionality of affricate retention, affricate simplification, and epenthesis IP-internally with word-final affricates is predicted by the non-ordering of *[-son,-cont]/___]PW→V, IDENT-[cont], and DEP-/a/.



4. Conclusion

The Ondarrao Basque data presented in this paper serve two purposes. First, they shed light on the behavior of final stops and affricates in Basque, calling for a revision of previous OCP-based accounts. Second, they suggest a different approach to edge effects, by which additional consonants are licensed at the end of prosodic constituents. Studies have so far focused almost exclusively on the word level, but the presence of a three-way distinction between word-internal, word-final, and IP-final consonants in Ondarrao suggests an extension of edge effects to all prosodic constituents. The data also display two additional properties: 1. Edge effects are cumulative as we go up the Prosodic Hierarchy; 2. Stops are particularly subject to context-based alternations, i.e. they are especially vulnerable in domain-internal position, but privileged targets of edge licensing.

The cumulative effect and the special status of stops tie in nicely with the perceptually-based account of edge effects I develop. The weakness of internal cues to stops, as opposed to other consonants, makes them more dependent on the context where they appear. They are therefore particularly at a disadvantage when lacking the informative CV transitions. But domain-final positions offer a possible compensation through the effects of lengthening, strengthening, and reduction of overlap that are associated with them, and which provide final segments with increasing additional salience, as we go up the Prosodic Hierarchy. These phonetic factors motivate a series of constraints against non-prevocalic consonants, which integrate the type of consonants (based on the quality of their

non-contextual cues) and the prosodic context. This syllable-free account does away with the notions of extraprosodicity and resyllabification that are central in other proposals.

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