Prominence-driven epenthesis: evidence from Catalan*

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1 Introduction

Studies on epenthesis have proved that there are different strategies available to determine the quality of the inserted vowel: default insertion on the basis of perception (cf., among others, Prince & Smolensky 1993, Kenstowicz 1997, Steriade 2001, de Lacy 2002, Gouskova 2003); default insertion on the grounds of segmental markedness determined by each specific phonological system (cf., among others, Archangeli 1984, Pulleyblank 1988, Lombardi 2003 and, for Catalan, Palmada 1994), and default insertion derived from assimilatory processes such as vowel harmony and consonant assimilation (cf., among others, Smith 1977, Kitto & de Lacy 1999). It is far from clear, though, how these strategies interact in individual languages. Recent interest on loan adaptation has renewed attention to this topic (e.g. Uffmann 2004, 2006, Rose & Demuth 2006), but there still are few studies that address this question based on languages that show different epenthetic vowels in specific contexts not determined by assimilation or loanword phonology. The present paper primarily sheds light on this topic through the study of epenthesis in Alghero Catalan (AC, henceforth), which is the Catalan variety spoken in the Sardinian town of Alghero (Italy).

AC uses two different epenthetic vowels: [a] at the word level and [i] across words, each of them appearing in a different phonological context, not determined by assimilation. It thus challenges parallel, monostratal approaches to epenthesis, as well as the claim that in epenthesis, except for assimilatory environments, the same default vowel is always inserted. Our goal is to offer a parallel analysis of these facts and show that the selection of one or the other vowel is not arbitrary. We propose (in line with work by de Lacy 2002, Uffmann 2004, 2005) that vowel selection such as that of AC is driven by prominence and is better explained within the Optimality Theory (OT) framework. We further claim that prominence plays an important role regarding other contextual differences in vowel quality found in western Catalan as well as on the topic of obstruent voice neutralisation. The work is structured as follows. §2 provides the basic description of the Catalan vowel systems under discussion. §3 discusses the motivation for epenthesis. §4 accounts for the site of the two epenthetic vowels that AC shows. §5 looks at different approaches to vowel selection, argues for a parallel prominence-driven OT approach to the AC data and extends the analysis to other facts of western Catalan. §6 suggests a possible serial approach to AC vowel selection and faces the serial with the parallel view in the light of voice neutralisation. §7 presents conclusions.

2 Data

Catalan has a seven-vowel system in stressed position ([i], [u], [a], [e], [ɛ], [o], [ɔ]), but a reduced system in unstressed position. AC, like central Catalan (the variety spoken in Barcelona and surrounding areas), has a three-vowel stressless system: AC shows [i], [u] and [a], while central Catalan shows [i], [u] and [ə] (low and mid front vowels merge as [a] in AC and as [ə] in central Catalan; non-low back vowels merge as [u] in both dialects).

Western varieties (i.e. Valencian and north-western Catalan) have a five-vowel stressless system: [i], [u], [a], [e] and [o] (mid front vowels merge as [e] while mid back vowels merge as [o]). From these systems, AC selects [a] as word epenthesis (1)a and [i] as epenthesis across words (1)b. As shown in (1)b, [i]-epenthesis is not part of any word, because it is not used to repair structures that come up ill-formed at the word level nor to satisfy minimal word requirements, but it undoes certain consonant contacts that arise phrasally: in isolation, or phrase finally, words like [tót], [sént] and [pɔ́lk] are realised with a final stop, without a flanking final vowel. The other Catalan dialects only show word epenthesis: central Catalan uses [ə] as epenthesis (2)a, while western Catalan uses [a] (sometimes in variation with [e]) word-initially, and [e] elsewhere (3)a, an issue to which we shall return in §5.3. Throughout the paper, morphological segmentation is only indicated when words appear in isolation; epenthetic vowels are underlined for clarity. (Word-epenthesis is represented by <e> in standard orthography, except in recent loans.)[1]

(1) Alghero Catalan

a.	espina	/spín-a/	[a̲s.pí.na]	'spine'	(-/a/ = FEM)
	espaguets	/spagét-z/	[a̲s.pa.g͡éts]	'spaghetti'	(-/z/ = PL)[2]
	Snoopy	/snúpi/	[a̲z.nú.pi]	'Snoopy'	
	sofre	/sófr/	[só.fra̲]	'sulphur'	
	ventre	/véntr/	[vén.tra̲]	'belly'	
	ventres	/véntr-z/	[vén.tra̲s]	'bellies'	
	coneixeré	/kunéʃ-ɾé/	[ku.na.ʃa̲.ɾé]	'I will know'	(-/ɾé/ 1st SG FUT)
b.	tot tapat	/tót tapád/	[tò.t i̲. ta.pát]	'all (SG) covered'	(cf. tot [tót])
	cent voltes	/sént vɔ́ltaz/	[sèn.t i̲. vɔ́l.tas]	'a hundred times'	(cf. cent [sént])
	porc món!	/pɔ́lk món/	[pɔ̀l.k i̲. món]	'damn it! (lit. *dirty world!*)' (cf. porc [pɔ́lk] 'dirty')	

(2) Central Catalan

a. [ə̲s.pí.na], [ə̲s.pə.ɣé.tis], [ə̲z.nú.pi]; [só.frə̲], [bén.trə̲], [bén.trə̲s], [ku.nə.ʃə̲.ɾé]

b. [tòt. tə.pát], [sem. bɔ́l.təs], [pɔrg. món]

(3) Western Catalan (examples from Valencian)

a. [a̲s.pí.na]~[e̲s.pí.na], [a̲s.pa.ɣé.tis]~[e̲s.pa.ɣé.tis], [a̲z.nú.pi]~[e̲z.nú.pi]; [só.fre̲], [vén.tre̲], [vén.tre̲s], [ko.nej.ʃe̲.ɾé]

b. [tòt. ta.pát]~[tò. ta.pát], [seɱ. vɔ́l.tes], [pɔr. món]

There is not [i]-epenthesis between the host and the clitic in AC (4)a, even though in some cases, as in *rentant-vos* 'washing yourselves', we find structures segmentally identical to those in (1)b. As expected, epenthesis occurs when a verbal form is followed by a clitic whose host is the verbal form behind it (i.e. the second verbal form of the sequences in (4)b). Compounds, in (5), behave, in general, like independent words with respect to

epenthesis; that is, there is epenthesis between both elements (5)a-b. Some compounds, though, maintain the old stage of the language, when simplification applied instead of epenthesis, sometimes in variation (5)b and others as lexicalised unique forms (5)c. (Examples are from Loporcaro 1997.)

(4)	a.	renta-te	[rén.ta.ta]	'wash yourself!'
		rentant-te	[ran.tán.ta]	'washing yourself'
		rentant-vos	[ran.táŋ.vus]	'washing yourselves'
	b.	rentant me só	[ran.tàn.t i̲. ma.só]	'I am washing myself'
		rentant te sés	[ran.tàn.t i̲. ta.sés]	'you are washing yourself'

(5)	a.	cent-seixanta	[sèn.t i̲. ʃi.ʃán.ta]	'one hundred and sixty'
	b.	cap de mort	[kà.p i̲. de. mɔ́lt]~[kà. de. mɔ́lt]	'skull' (lit. *head of dead*)
	c.	camp sant	[kan.t͡sánt]	'cemetery' (lit. *holy field*)

According to work by Kuen (1934), epenthesis applied optionally in the 1930's as an alternative to deletion. Loporcaro (1997) suggests that, at that time, its status resembled more that of an excrescent vowel than that of an epenthetic vowel (cf. Levin 1987, Hall 2006), because it is reported as having a variable phonetic nature: it is described as lower and/or more centralised than [i] and shorter than underlying vowels. Kuen reports, though, that it already counted as a syllabic nucleus for metrical parsing in traditional poetry and folk songs. Since the 1990's, its insertion is categorical and its realisation is no longer vacillating (i.e. it is like that of underlying /i/'s). In all respects, the occurrence, the metrical parsing, the quality and the duration of the inserted vowel show that nowadays [i]-insertion is not motivated on purely low-level phonetic grounds.

3 Motivation for epenthesis

3.1 Word epenthesis

Although there are many accounts of word epenthesis in Catalan from the perspective of traditional Generative Phonology (e.g. Wheeler 1975, Mascaró 1976), Autosegmental Phonology (e.g. Mascaró 1989, Palmada 1994) and Optimality Theory (e.g. Colina 1995, Jiménez 1997, Bonet & Lloret 2005, Wheeler 2005), it does not always clearly follow from the data that a process of epenthesis takes place. We mostly draw the discussion below from Wheeler (2005: §8.1).

Word-initially, we can infer from the surface forms that there are not *s*-initial clusters. The contrast between zero and the presence of [a]/[ə] (depending on the unstressed system of each dialect) is always lost in this position. Traditional words are represented orthographically by an initial <e> (e.g. **spina*, **sport*, **structura*; cf. *espina* 'spine', *esport* 'sport', *estructura* 'structure'); recent loans are only phonetically preceded by [a]/[ə] (e.g., in AC, [a]*Snoopy*).[3]

Word-finally, all we can deduce from the surface data is that there are not CC endings (except for Cs) that do not respect the sonority sequencing principle. Words ending in consonant groups that decrease in sonority are possible (e.g. *porc* 'dirty (MASC SG)', *cent* 'hundred', without overt inflectional endings as is the case of regular masculine singular nominals in Catalan). However, words ending in consonant clusters that increase in sonority are followed by <e> (e.g. **sofr*, **ventr*, but *sofre* 'sulphur', *ventre* 'belly'). The fact that the final vowel present in these simple words never shows up when vowel-initial suffixes are added to the root (e.g. *sofr-ós* 'sulphureous', *ventr-al* 'ventral') suggests that it can be interpreted as epenthetic. But epenthesis is not the only plausible explanation, because inflectional vowels do not show up either when they would be followed by a vowel-initial suffix (e.g., in AC, *calç-a* 'stocking (FEM)', but *calç-ó* 'trousers'). Roots ending in a vowel do not provide clear evidence for the nature of these final <e>. In Catalan, there are very few such roots and they all do maintain the final root vowel (e.g. *àre-a* 'area', *are-al* 'areal'; *tràque-a* 'trachea', *traque-ïtis* 'tracheitis'). Wheeler suggests that the final vowels of words like *sofre* and *ventre* could be interpreted as part of the input. He appeals to a truncation process to explain the loss of the simple-word final vowel in suffixation, with the proviso that the truncation is stated in a way such that deletion is limited to the last element of the input. This would allow for the loss of word-edge vowels (e.g. [[sofr~~e~~]$_{Wd}$ ós]$_{Wd}$, [[ar~~ea~~]$_{Wd}$ al]$_{Wd}$, [[traqu~~ea~~]$_{Wd}$ ïtis]$_{Wd}$), but would penalise the loss of word-internal vowels (as the *e* in *[[ar~~e~~a]$_{Wd}$ al]$_{Wd}$, *[[traqu~~e~~a]$_{Wd}$ ïtis]$_{Wd}$).[4]

Word-internally, we infer from the surface data that certain CC sequences do not occur, because they are barred either from onset clusters (e.g. onset *ʃɾ, as in AC: /kunéʃ-ɾé/, *[ku.na.ʃɾé] 'I will know') or from intersyllabic contacts (e.g. *ʒ.ɾ, *ʒ.r, *z.ɾ, *z.r, as in AC: *[ku.naz.ɾé], *[ku.naz.ré], with obligatory depalatalisation of /ʃ/ in internal coda position and regressive voice assimilation). In such cases, an intervening <e> always occurs (e.g., in AC: [ku.na.ʃa̲.ɾé]). The morphological evidence for the epenthetic nature of these vowels comes from comparison to the conjugational paradigms without sonority problems: in none of these cases the intervening vowel occurs (e.g., in AC: /kunéʃ/ [ku.néʃ] 's/he knows', [ku.na.ʃa̲.ɾé]; but /kɾéw/ [kɾéw] 's/he believes', /kɾéw-ɾé/ [kɾaw.ɾé] 'I will believe'). Hence, the epenthetic status of these word-internal <e>'s is conceivable.

Loporcaro (1997) is the only work that addresses the issue of AC syllable structure in depth. In his non-OT analysis, he takes the view that word epenthesis does not exist in AC, that is, that all [a]'s are lexical and thus are present in the input. In our view, there are two reasons for considering [a] epenthetic. One is theoretically based and the other is empirically based. From an OT perspective, given Richness of the Base ('*all* inputs are possible in all languages', Prince & Smolensky 1993: 225), we must consider both possibilities: the presence of [a] in the input and its absence. Lexicon Optimisation would select the input with the final vowel, because it gives a more harmonic mapping. But Minimal Redundancy favours the input with least underlying material, i.e. the one without the final vowel. In any case, the hierarchy of constraints must account for the fact that certain forms always surface with a final vowel, as *sofre* or *ventre*, while other forms occur without it, as *cent* or *porc*. The second piece of evidence for the epenthetic nature of [a] is empirical: loans that have a syllabic problem are repaired through [a] insertion (e.g. [a̲]*spaguets*, [a̲]*Snoopy*), and not through deletion as done in medial clusters (e.g. *Andreotti*

[an.dɾe.ɔ́.ti]; *esballat* [a̲z.ba.ʎát] ‘wrong’, from Italian *sbagliato* [zbaʎ.ʎá.to], with initial epenthesis but consonant simplification).

In Catalan the trigger of word epenthesis is syllable structure, which in previous works has been analysed resorting to the usual sonority constraints (i.e. *P/C, SONORITYSEQUENCE, SYLLABLECONTACT and SONORITYDISTANCE). A further remark is in order concerning verbal morphology. AC —as well as Balearic Catalan— has maintained the old forms of 1st person-singular present indicative, which do not have any overt inflectional ending. Stems appear in their bare form and do maintain final clusters that violate the sonority sequencing principle (e.g. *ensofr* [an.sófr] ‘I sulphurate’, *entr* [éntr] ‘I enter’). Hence, we end up having pairs like *ensofr* ‘I sulphurate’, without epenthesis, and *sofr*[a̲] ‘sulphur’, with epenthesis. Epenthesis does apply, though, in other verbal forms, as in certain verbs along the whole future paradigm (e.g. /kunéʃ-ɾé/ [ku.na.ʃa̲.ɾé], /kunéʃ-ɾá-z/ [ku.na.ʃa̲.ɾás]… ‘I will know’, ‘you will know’…). The treatment of the special endings that appear in 1st person-singular present indicative forms has been discussed at length in the literature, either as an effect of a special Ø verbal morph (e.g. Dols 1993, Serra 1996), as an effect of cyclicity (e.g. Dols & Wheeler 1996) or as a paradigmatic effect (e.g. Lloret 2003, 2004a, b, Pons 2004, Wheeler 2005; this is also the view taken from the historical perspective, see a review in Pérez Saldanya 1998). The analysis of these forms relates to other phonological differences that occur between nouns and verbs in Catalan, which are better captured in terms of paradigms and thus are not at issue here.[5]

Leaving aside the aforementioned special verbal forms, the basic ranking at work is given in (6). Here, we use SONORITY as shorthand to cover different sonority-related constraints.[6] The sonority scale assumed is the following: Vowels > Glides > Liquids > Nasals > Sibilant fricatives > Obstruents (f, stops, affricates) (cf. §3.2 for further discussion).

(6) Basic ranking: AGREE-PLACE, SON » MAX » DEP » *CODA
(7) AGREE-PLACE: A [–cont] consonant and a following consonant must agree in Place.
(8) SONORITY (SON): Shorthand to cover different sonority-related constraints (*P/C, SONORITYSEQUENCING, SYLLABLECONTACT, SONORITYDISTANCE).
(9) MAX-C (MAX): Every C-element of S_1 has a correspondent in S_2.
(10) DEP-V (DEP): Every V-element of S_2 has a correspondent in S_1.[7]
(11) *CODA: Codas are avoided.

When a word-initial cluster respects SON, no change occurs (e.g. /bɾás/, [bɾás] ‘arm’). However, if an initial cluster does not respect the required (onset) rise in sonority (12), [a] is inserted to satisfy SON because MAX outranks DEP (cf. (12)c).

(12)

/spín-a/ ‘spine’	AGR-PL	SON	MAX	DEP	*CODA
a. spí.na		*!			
b. pí.na			*!		
☞c. a̲s.pí.na				*	*

Word-finally, there is no change if SON is respected (e.g. /tót/ [tót] ‘all (SG)’, /kunéʃ/ [ku.néʃ] ‘s/he knows’, /sént/ [sént] ‘100’, with possible AC phrase-final codas). But if a final cluster does not respect the required (coda) drop in sonority, as in (13)a, the candidate with epenthesis, (13)c, wins again. In (14)c, AGREE-PLACE ensures place assimilation, which is compulsory in AC for the case of (coda) preconsonantal nasals and stops; affricate formation solves the sonority problem posed by stops followed by *s*, since they always end up as an affricate in AC codas (e.g. *tots* [tó͡ts] ‘all (PL)’, *focs* [fɔ́͡ts] ‘fires’). (Onset consonants would be protected by the usual positional faithfulness constraints.)

(13)

/véntr/ ‘belly’	AGR-PL	SON	MAX	DEP	*CODA
a. véntr		*!			*
b. vént			*!		*
☞c. vén.tra				*	*

(14)

/táp-z/ ‘corks’	AGR-PL	SON	MAX	DEP	*CODA
a. táps	*!	*			*
b. táts		*!			*
☞c. tá͡ts					*
d. tá.pas				*!	*

In forms such as /kunéʃ-ɾé/ ‘I will know’ the consonant cluster /ʃr/ cannot be adjacently syllabified in two syllables (cf. (15)a, with depalatalisation of /ʃ/ in internal coda position and regressive voice assimilation), because the sonority increases across the syllable boundary (a violation of SYLLABLECONTACT), nor can it be syllabified as a legal onset in Catalan (cf. (15)b), because there is not a sufficient sonority distance between the two members of the cluster (a violation of SONORITYDISTANCE). Hence, the candidate with epenthesis, (15)e, is selected again.

(15)

/kunéʃ-ɾé/ ‘I will know’	SON	MAX	DEP	*CODA
a. ku.naz.ré	*!			*
b. ku.na.ʃré	*!			
c. ku.na.ɾé		*!		
d. ku.na.ʃé		*!		
☞e. ku.na.ʃa.ɾé			*	

3.2 Epenthesis across words

Epenthesis across words is a distinctive characteristic of AC. The vowel [i] is inserted to avoid internal complex codas (16)a, except for glide plus *s* clusters (16)b and glide plus nasal clusters (16)c. It is also inserted to avoid *f*, stops and affricates as internal simple codas (16)d. Epenthesis does not occur when the first word ends in any other single

consonant, whatever the resulting sonority profile is; that is, there is not epenthesis after a word ending in a sibilant fricative (16)e, nor after a word ending in a sonorant (16)f.[8]

(16)	a.	cent voltes	[sèn.t i̲. vɔ́l.tas]	‘a hundred times’
		porc món	[pɔ̀l.k i̲. món]	‘damn it!’
		pouc també	[pù(w).k i̲. tam.bé][9]	‘I’m drawing water also’
		animals petits	[a.ni.màl.t͡s i̲. pa.tít͡s]	‘small animals’ (cf. /animál-z/ [a.ni.mál͡ts])
	b.	cous bé	[kɔwz. bé]	‘you cook well’ (cf. [majs.trál] ‘NW wind’)
		beus whiskey	[bewz. wís.ki]	‘you drink whiskey’
	c.	diun coses	[diwŋ. kɔ́.zas]	‘they say things’
		fer un praier	[fè wm. pra.jé]	‘to make a pleasure’
	d.	viv bé	[vì.f i̲. bé]	‘I live well’ (cf. /vív/: [víf])
		viv també	[vì.f i̲. tam.bé]	‘I live also’
		tot tapat	[tò.t i̲. tap.át]	‘all (SG) covered’ (cf. /tót/: [tót])
		bec whiskey	[bè.k i̲. wís.ki]	‘I drink whiskey’ (cf. /bég/: [bék])
		tots tenim	[tò.t͡s i̲. ta.ním]	‘all of us have’ (cf. /tót-z/: [tó͡ts])
		desig feo	[da.zì.t͡ʃ i̲. fɛ́w]	‘bad desire’ (cf. /dazíd͡ʒ/: [da.zí͡tʃ])
	e.	és tot	[es. tót]	‘it is all’
		sés malanada	[sèz. ma.ɾa.ná.ɾa]	‘you are unlucky’
		fulles rodones	[fù.ʎaz. ru.ɾó.nas]	‘round leaves’
		és la missa	[èz. la. mí.sa]	‘it is the mess’
		és whiskey	[ez. wís.ki]	‘it is whiskey’
	f.	un mostatxo	[um. mus.tá.t͡ʃu]	‘a moustache’
		un record	[un. ra.kɔ́lt]	‘a memento’
		un whiskey	[uŋ. wís.ki]	‘a whiskey’
		vol bé	[vɔl. bé]	‘s/he wants (it) well’
		vol whiskey	[vɔl. wís.ki]	‘s/he wants whiskey’
		cou bé	[kɔw. bé]	‘s/he cooks well’
		beu whiskey	[bew. wís.ki]	‘s/he drinks whiskey’

From the examples above, it is clear that epenthesis between words is not merely triggered by syllabic reasons. We cannot, for instance, appeal to the syllable contact law to justify [i]-epenthesis, because in (16)a and (16)d there are cases with epenthesis whose input clusters show a flat sonority (e.g. [tò.t i̲. ta.pát]), as well as cases with epenthesis like [vì.f i̲. tam.bé] for which one could even assume, under the common version of the sonority scale according to which fricatives are more sonorous than stops, that the input cluster shows a falling sonority. Additionally, in (16)e-f we find cases without epenthesis

whose contacts show a higher degree of rising sonority (e.g. [ez. wís.ki], [uŋ. wís.ki]) than other cases that trigger epenthesis (e.g. [tò.t i̲. ta.pát], [vì.f i̲. tam.bé] in (16)d). All in all, the conclusion is that [i]-insertion is not related to the nature of the following consonant, but it is related to the nature of the consonants that appear in coda position.[10]

An important observation is in order regarding the pronunciation of phrase-final stops. In AC, contrary to other Catalan dialects, stops are pronounced with a release burst in phrase-final position. The pronunciation of a word like *tot*, for example, is [tót], with a clearly audible release burst, and not [tót˺], without a release, as it is pronounced in other Catalan dialects. It is not surprising, then, that in dialects with restrictions on preconsonantal coda stops AC resorts to epenthesis while other dialects resort to deletion (e.g., in some Valencian varieties, *tot tapat* [tò. ta.pát], *tots tenim* [tòs. ta.ním] vs. [tò.t i̲. ta.pát], [tò.t͡s i̲. ta.ním] in AC). We could assume that in AC [i]-epenthesis occurs to protect stop releases in preconsonantal codas. However, the additional vowel is not only found when stops occur in preconsonantal codas (the worst position for the recoverability of the stop release burst), but [f] as well as sibilant affricates also induce epenthesis in the same context (cf. (16)d). Hence, we need a more general motivation for epenthesis.

Following work by Padgett (1997), Steriade (1999, 2001), Côté (2000) and Wright (2004), among others, we assume that a combination of factors affect the perceptibility of certain consonants depending on their nature and on the position in which they occur. Our claim is that epenthesis across words in AC is conditioned by such factors. The segments that benefit from the inserted vowel are the ones that have vulnerable cues, such as consonant bursts or weak friction in simple preconsonantal codas and consonants with poorer cues for auditory perception in complex preconsonantal codas. In simple codas, this is the case for stops and [f], the fricative with low intensity of friction. These segments suffer from masking, especially in the worst position, i.e. in preconsonantal coda position and, particularly, when more consonants appear together because in this site the characteristics of the consonants are hidden by the overlapping articulation of the following consonant. Sibilant affricates (with a stop portion and a fricative release) suffer from masking in preconsonantal coda position too, due to their complex nature.[11] We appeal to the constraint *WEAKCUES in (17) to penalise the poor acoustic cues (or perceptual weakness) of the internal codas that trigger [i]-epenthesis in AC.[12]

(17) *WEAKCUES: A segment must have perceptual cue robustness.

The perceptual explanation we are putting forward does not conflict with past formulations of the sonority sequencing principle based on the most traditional view of sonority as degree of stricture. On the contrary, the AC data matches the complexity ranking proposed in Clements (1990), providing the fact that Clements groups all obstruents together (18). (V = vowel, L = liquid, N = nasal, O = obstruent.)

(18) a. 2-member final demisyllables
VG (complexity 1) > VL (2) > VN (3) > VO (4)
b. 3-member final demisyllables
VGL (1) > VGN, VLN (2) > VGO, VNO (3) > VLO (4)

The most complex two-member final demisyllable in Clements' account is a vowel followed by an obstruent (with a complexity of 4), which, with the exclusion of sibilant fricatives, is the one-obstruent coda that induces epenthesis between words in AC. On the other hand, in the three-member final demisyllables the most complex ones (those with a complexity of 3 and 4, excluding the cases with sibilant fricatives) also entail epenthesis. Interestingly enough, except in this context, the phonology of Catalan does not show visible effects of Clements' rankings in word-final position. In fact, things seem to go the other way around, since final demisyllables of high complexity are clearly favoured over those with low complexity. For example, there are many words ending in three-member demisyllables of complexity 4 (i.e. words ending in VLO: *porc* 'dirty', *alt* 'tall'), but none of complexity 1 (i.e. words ending in VGL) and very few of complexity 2 (i.e. words ending in VGN: *diun* [dǐwn] 'they say' in AC).[13] It is only through [i]-epenthesis between words that the effects of Clements' rankings outcome, emerging as inducers of vowel insertion.

Table 1 summarises the facts of AC with respect to codas (excluding the aforementioned special verbal forms). From now on, we use 'O' to refer to the non-sibilant fricative ([f]), stops and affricates in the sonority scale. Combinations preceded by a star indicate that they do not occur in AC. The relevant fact to grasp in this table concerns the data presented in the shaded rows. See that in final position demisyllables of high complexity are allowed. That is to say, demisyllables with a final O are accepted phrase-finally: VO, VGO, VLO, VNO and VSO. However, the same structures trigger epenthesis in internal position. In sum, the most complex demisyllables (the ones ending in an O) are avoided in the least perceptible position (preconsonantal codas). (V = vowel, G = glide, L = liquid, N = nasal, S = sibilant fricative, O = f, stop, affricate; sonority scale: V > G > L > N > S > O. Wheeler 2005: 255 also proposes a sonority scale for Catalan with sibilant fricatives being more sonorous than other obstruents for independent reasons.)

Table 1. Decreasing *perceptibility* in final demisyllables →

	VC		VCC							
FINAL	VG	kɔ́w								
	VL	bél	*VGL							
	VN	fém	VGN	dɪ́wn	*VLN[a]					
	VS	és	VGS	réjs	*VLS[b]		*VNS[c]			
	VO	tót	VGO	pú(w)k	VLO	pɔ́lk	VNO	sént	VSO	víst
INTERNAL	VG	kɔw. bé								
	VL	bèl. pra.jé	*VGL							
	VN	fèm. pra.jé	VGN	fè wm. pra.jé	*VLN[a]					
	VS	es. tót	VGS	kɔwz. bé	*VLS[b]		*VNS[c]			
	*VO	tò.t i. ta.pát	*VGO	pù(w).k i. tam.bé	*VLO	pɔ̀l.k i. món	*VNO	sèn.t i. vɔ́l.tas	*VSO	vìs.t i. tót

[a] rC > lC and -ln > -l: *carnassa* [kal.ná.sa] ‘bad meat’, *carn* [kál] ‘meat’

[b] Intrusive stop: LS > LO, [l͡ts]: *persona* ‘person’, *car-s* ‘expensive (PL)’, *animal-s* ‘animals’

[c] Intrusive stop: NS > NO, [n͡ts]: *man-s* ‘hands’, *any-s* ‘years’, *funció* ‘function’

The constraint *WEAKCUES (*WC) penalises the low perceptibility of the internal codas shaded in table 1. The ranking at work is the one presented in (6) with the addition of *WEAKCUES high in the ranking, cf. (19). We also include the constraint MAX-MANNER to ensure that manner specifications are not changed to satisfy *WEAKCUES. In tableau (20), candidate (20)a illustrates a case where *WEAKCUES is violated due to the presence of an unreleased stop in preconsonantal coda position. Note that even if the result is a stop geminate, the first element of the resulting geminate does not satisfy *WEAKCUES, because stops show poor cues and there is not sufficient perceptual distance between the two adjacent segments to satisfy the perceptual requirement (Ohala 1992 and Flemming 2002 appeal to the same factors to motivate OCP). Candidate (20)c, with an epenthetic vowel, wins over candidate (20)b, with deletion, because MAX outranks DEP. The same situation follows when the first word ends in a complex segment or in a complex coda: in all cases *WEAKCUES triggers epenthesis to improve the perception of the original coda consonants.

(19) Ranking: MAX-MANNER, *WEAKCUES, AGREE-PLACE, SON » MAX » DEP » *CODA

(20)

/tót tapád/ 'all (SG) covered'	MAX-MAN	*WC	AGR-PL	SON	MAX	DEP	*CODA
a. tòt.ta.pát		*!					**
b. tò.ta.pát					*!		*
☞c. tò.ti̲.ta.pát						*	*

The constraint MAX-MANNER accounts for the preference of epenthesis over manner assimilation, even when the result would not violate *WEAKCUES. Candidate (21)b, with nasal assimilation, satisfies *WEAKCUES due to the presence of a nasal in preconsonantal coda position, but it is nevertheless discarded by the high-ranked constraint MAX-MANNER. The candidate with epenthesis, (21)c, wins again. (For simplicity, from now on in the tableaux we only include candidates that are relevant to the discussion in progress.)

(21)

/tót naturál/ 'all (SG) natural'	MAX-MAN	*WC	AGR-PL	SON	MAX	DEP	*CODA
a. tòd.na.tu.ɾál		*!		*			**
b. tòn.na.tu.ɾál	*!						**
☞c. tò.ti̲.na.tu.ɾál						*	*

Tableau 0 considers a case of preservation of internal codas with sufficiently strong cues. Candidate 0b, with manner assimilation, is discarded by MAX-MANNER. The ranking of DEP above *CODA eliminates candidate 0c, with epenthesis, and 0a, with a sonorant consonant in the coda, is selected.

(22)

/vɔ́l negáɾ/ ‘s/he wants to deny’	MAX-MAN	*WC	AGR-PL	SON	MAX	DEP	*CODA
☞a. vɔ̀l.na.gá							*
b. vɔ̀n.na.gá	*!						*
c. vɔ̀.li̲.na.gá						*!	

Between a word ending in a stop and a word beginning with a sibilant fricative there is epenthesis, and not affricate formation, even though an affricate in an onset satisfies *WEAKCUES. The lack of affricate formation is an effect of the constraint ALIGN-LEFT(PrWd, σ) (23). This constraint requires that the beginning of a prosodic word coincides with the beginning of a syllable; that is to say, it guarantees that the syllabic profile of the word in isolation is maintained at the phrasal level, preventing affricate formation (cf. (24)a) as well as other non-possible resyllabifications in Catalan (cf. (24)b) (e.g. Colina 1995, Jiménez 1997, Dols 2000, Wheeler 2005). ALIGN-LEFT(PrWd, σ) is only violated to avoid onsetless syllables (cf. (24)c), with the ranking ONSET » ALIGN-LEFT(PrWd, σ).[14] The tableau in (25) broadly illustrates the evaluation of the AC example in (24)a.

(23) ALIGN-LEFT(PrWd, σ) (AL-L): Align the left edge of a prosodic word with the left edge of a syllable. (McCarthy & Prince 1993)

(24)

a.	tot segur	[tò.t i̲. sa.gúr], *[tò.t͡sa.gúr] (AC)	‘all (SG) sure’
b.	bec líquido	[k i̲. l], *[g.l], *[.gl], *[.kl] (AC)	‘I drink liquid’
	bec líquid	[g.l], *[.gl], *[.kl] (other Catalan dialects)	
	pot riure	[t i̲. r], [d.r], *[.dɾ], *[.tɾ] (AC)	‘s/he can laugh’
		[d.r], *[.dɾ], *[.tɾ] (other Catalan dialects)	
c.	tot útil	[to.t ú.til] (all Catalan dialects)	‘all (SG) useful’

(25)

/tót sagúr/ ‘all (SG) sure’	*WC	ONSET	AL-L	DEP
a. tòt.sa.gúr	*!			
b. tò.t͡sa.gúr			*!	
☞c. tò.ti̲.sa.gúr				*

4 Site of epenthesis

In Catalan, the place of insertion of epenthetic vowels is in general conditioned by the constraint O-CONTIGUITY, which bans morpheme internal epenthesis (26) (e.g. [a̲s.pí.na], *[sa̲.pí.na] ‘spine’; [vén.tɾa̲], *[vén.ta̲r] ‘belly’; cf., for Catalan, Colina 1995, Jiménez 1997, Bonet & Lloret 2005, Wheeler 2005, among others). Tableaux (28)-(30) illustrate this general tendency. O-CONTIGUITY is not violated when the epenthesis appears at the edge of a morpheme, cf. (28)a, or between morphs, cf. (29)a, or across words, cf. (30)b. In the tableaux below, we concentrate on the facts related to the site of epenthesis; in §5.2 we deal with the issue of [a]/[i] selection.

(26) O-CONTIGUITY (O-CONT) ('No Intrusion'): The portion of S_2 [i.e. an output string] standing in correspondence forms a contiguous string. (McCarthy & Prince 1995)

(27) O-CONT, MAX-MANNER, *WEAKCUES, AGREE-PLACE, SON » MAX » DEP » *CODA

(28)

/véntɾ/ 'belly'	O-CONT	*WC	SON	MAX	DEP	*CODA
☞a. vén.tra					*	*
b. vén.tar	*!				*	**

(29)

/véntɾ-z/ 'bellies'	O-CONT	*WC	SON	MAX	DEP	*CODA
☞a. vén.tras					*	**
b. vén.tars	*!				*	**

(30)

/sént tápz/ '100 corks'	O-CONT	*WC	SON	MAX	DEP	*CODA
a. sent.táts͡		*!				**
☞b. sèn.ti.táts͡					*	**

Across words, though, we must consider the possibility that in some cases word [a]-epenthesis, and not [i]-epenthesis, could repair the contact problem, as in /vɔ́l-z féɾ/ 'you want to do' resolved as the ungrammatical form *[vɔ̀.las. fé], (33)b, instead of the grammatical one, [vɔ̀l.ts͡ i. fé], (33)c. Both candidates satisfy O-CONTIGUITY and fare even for all other constraints. In order to get the grammatical result, (33)c, we appeal to the contiguity constraint that ensures that words are kept as similar as possible to their realisation in isolation —the base— with respect to the adjacency of segments: OO-CONTIGUITY (31).[15]

(31) OO-CONTIGUITY (OO-CONT): A word in a phonological phrase has the same contiguous string as its correspondent in a prosodic word. (Cf. CONT-BASE/RED in McCarthy & Prince 1995)

(32) OO-CONT, O-CONT, MAX-MANNER, *WEAKCUES, AGREE-PLACE, SON » MAX » DEP » *CODA

(33)

/vɔ́l-z féɾ/ 'you want to do' *Bases*: [vɔ́l͡ts], [fé]	OO-CONT	O-CONT	*WC	MAX	DEP	*CODA
a. vɔl͡ts.fé			*!			*
b. vɔ̀.las.fé	*!				*	*
☞c. vɔ̀l.ts͡i.fé					*	*

In sum, the requirement that the output segments respect the input adjacency relations justifies that the site of epenthesis follows the same structural pattern: the epenthetic vowel always appears at the edge of the affected domain, being the edges those of morphs (cf. [a]*spina*, *ventr*[a], *ventr*[a]*s*) or those of words (cf. *cent* [i] *taps*).

5 Vowel selection

Up to now, we have motivated the appearance and the site of the two epenthetic vowels through the ranking of familiar constraints, but we have not dealt with the primary concern of our study: the reasons for the selection of [a] in word epenthesis but [i] across words. We devote this section to this issue.

5.1 The nature of the inserted vowel

The reduced stressless system that AC has displays the three corner vowels [i], [u] and [a], which according to functional approaches correspond to the maximally distinct vowels preferred in a context of disfavouring perceptual contrasts such as unstressed position (cf. Lindblom 1986). Hence, AC follows the best pattern of contrast-enhancing reduction (cf. Crosswhite 1999, 2004). Among the corner vowels, [u] is discarded as epenthesis because of its marked labial character (cf. de Lacy 2002, Lombardi 2003).[16] On phonetic grounds, the other two corner vowels, [a] and [i], can be both selected as optimal nuclei for epenthesis from a perceptual point of view. The selection of [a] is motivated by the fact that the most sonorous vowel is the best nucleus (34)a. On the other hand, the selection of [i] is grounded on the basis that low sonority vowels are preferred in less prominent positions, such as epenthetic sites (34)b. The choice of [i]-epenthesis on the basis of weak prominence goes along the lines of Steriade's (2001) work, according to which the best epenthesis is perceptually minimal, i.e. closest to zero (ə ≻ i ≻ ... ≻ a). AC does not have schwas, and thus chooses the next perceptually minimal vowel, [i], as epenthesis.

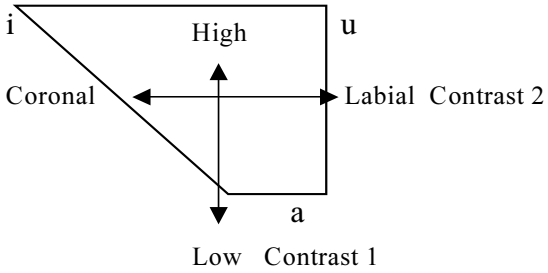
(34) Perceptual approach, based on phonetic grounds (cf. Prince & Smolensky 1993, Kenstowicz 1997, de Lacy 2002, Gouskova 2003)
   a. Most sonorous vowels are the best nuclei (peaks)
      - P/a ≻ P/ɛ,ɔ ≻ P/e,o ≻ P/i,u ≻ P/ə
   b. Least sonorous vowels are the best margins
      - M/ə ≻ M/i,u ≻ M/e,o ≻ M/ɛ,ɔ ≻ M/a

On the basis of (34)a, the selection of [a] as epenthesis is motivated and, on the basis of (34)b, the selection of [i] is motivated as well. The question that remains open is how these vowels are selected in the different slots they appear in AC.

An alternative approach is to base the selection on phonological grounds. Under this view, epenthesis is language-specific and the vowel selected is the least marked segment (underspecified in certain accounts) of each system (cf., among others, Archangeli 1984, Pulleyblank 1988, Lombardi 2003 and, for Catalan, Palmada 1994). Regarding AC, [a] can

be selected as epenthesis because it is the least marked vowel of the unstressed system, insofar as high vowels contrast in place between them while the low vowel does not have any specification for place because it does not contrast with any other low vowel (see Figure 1): [a] only displays a height feature ([a] = {Low}), without specifications for colour, as is the usual case for low vowels (cf. Archangeli 1988, Pulleyblank 1988, Kirchner 1993, Rose & Demuth 2006 and, for Catalan, Palmada 1994, Wheeler 2005); contrariwise, [i] and [u] display height and colour features ([i] = {High, Coronal}, [u] = {High, Labial}). On these bases, we can justify the selection of [a] but not the simultaneous presence of [i] as epenthesis.[17]

Figure 1. AC unstressed vowel contrasts



A potential solution is to resort to a mixed approach and claim —in line with work by Rose & Demuth (2006)— that both the perceptual component of the grammar (in order to pick [i]) and the phonological one (in order to pick [a]) intervene in the selection of the inserted vowel. Under this account, the phonetically based epenthesis emerges as a phonetic effect and is considered to be featureless. In AC, though, epenthetic [i] not only is reported as being phonetically like those derived from /i/ but it phonologically behaves as any other input vowel. For example, AC, like all other Catalan dialects, shows word-final obstruent devoicing (e.g. *desig* /dazíd͡ʒ/, [da.zít͡ʃ] 'desire', but *desitjar* [da.zi.d͡ʒá] 'to desire'; *cas* /káz/, [kás] 'case', but *casos* [ká.zus] 'cases'). It also shows coda obstruent voice assimilation to a following consonant, another general fact of Catalan (e.g. *cous bé* [kɔwz. bé], *[kɔws. bé] 's/he cooks well'). Epenthetic [i] blocks regressive voice assimilation from a following consonant, as any other vowel does, which shows that [i] is not transparent (e.g. *desig bo* [da.zì.t͡ʃ i̲. bɔ́], *[da.zì.d͡ʒ i̲. bɔ́] 'nice desire', as in *desig igual* [da.zì.t͡ʃ i.gwál] 'same desire').[18] In §6, we take up the issue of voice neutralisation again.

5.2 A parallel prominence-driven approach

The functional approach that we propose here develops the idea that the two types of prominence-driven epenthesis (i.e. the one benefiting [a] as the best peak and the one benefiting [i] as the best margin) may overlap, as they do with respect to vowel reduction. Previous work on sonority combines different heads/non-heads of constituents with the sonority hierarchy. Typically, they refer to nucleus *vs.* onsets (Prince & Smolensky 1993)

and to foot heads *vs.* foot non-heads (Kenstowicz 1997); more recent proposals further refer to head syllables of prosodic words (i.e. the syllables on which stress is realised) *vs.* non-head syllables (de Lacy 2002, 2004). Our claim is that the offside position of a prosodic word is a weak position too, a less prominent position with respect to the prosodic word itself, and this asymmetry justifies [a]/[i] vowel-epenthesis selection in AC. That is, prosodic-word-in elements (PrWd-Ins) stand to prosodic-word-off elements (PrWd-Offs) in the same relation as nucleus / foot head / head syllable stand to onset / foot non-head / non-head syllable. A precedent of such view is found in de Lacy's (2002: §4.4.2) work, where he analyses the difference in the epenthetic vowel quality of the Peruvian language Shipibo according to the foot position in which it occurs. (On consonant epenthesis motivated by prominence, see Uffmann 2005.)

Shipibo has the surface vowels [ɨ, i, ʊ, a]. An epenthetic vowel is inserted to avoid codas, but [a] is inserted in odd-numbered syllables (35)a while [i] appears in even-numbered syllables (35)b.

(35) a. /karib-kɨ/ [karibakɨ] 'went again'
b. /jʊnʊ-rib-kɨ/ [jʊnʊribikɨ] 'commanded again'

De Lacy derives this variation from the fact that most sonorous vowels are preferred in foot-head position (or strong syllable of a foot), while low sonority vowels are preferred in non-heads (or weak syllables in a foot), e.g. [(kári)(bàkɨ)] but [(júnʊ)(rìbi)kɨ].[19] The prediction made by de Lacy's analysis is that in languages where the quality of the epenthetic vowel differs depending on the position, the more sonorous vowel will appear in a prosodically stronger position. In our view, the AC data, which are not sensitive to feet with respect to epenthesis, add to de Lacy's pattern by exhibiting insertion of [a] within the prosodic word and insertion of [i] off the prosodic word. Along the same lines, non-head positions show a parallel distinction within the prosodic word, being word-initial position more prominent, stronger than word-internal and word-final position (on weak structural positions within the prosodic word, see Hagstrom 1997, Kiparsky 2003; on the prominence of word-initial position, see Byrd 1996, Beckman 1998). Hence, the prediction now is that, if the difference in vowel selection occurs within the prosodic word (and it is not foot-oriented), the most prominent vowel will be that occurring in initial position. The facts of western Catalan that we analyse in §5.3 will confirm this argument too. (36) illustrates the prominence of different prosodic elements. (36)c-d correspond to the extension we propose to handle the data under discussion.

(36)	+ Prominent	– Prominent	
a.	Foot-Head	Foot Non-Head	(Kenstowicz 1997)
b.	Foot-Strongσ (Hd_{Ft})	Foot-Weakσ (Non-Hd_{Ft})	(de Lacy 2002, 2004)
c.	PrWd-Ins (Non-Hd_{PWIns})	PrWd-Offs (Non-Hd_{PWOffs})	
d.	PrWd-Initial (Non-Hd_{PWIn})	PrWd-Internal/Final (Non-$Hd_{PWNon\text{-}In}$)	

As said, vowels of high sonority are better suited to positions of high prominence (PrWd-Ins/Peaks), while low sonority vowels are better suited to low prominence positions

(PrWd-Offs/Margins). The constraints in (37) and their order in the hierarchy mirror the harmonic scales presented in (34).[20]

(37) Positional prominence constraint hierarchies
   a. Peak hierarchy (*P/V): *P/ə » *P/i,u » *P/e,o » *P/ɛ,ɔ » *P/a
   b. Margin hierarchy for *NON-HD/V: *NON-HD/a » *NON-HD/ɛ,ɔ » *NON-HD/e,o » *NON-HD/i,u » *NON-HD/ə

The quality of the vowel selected in each position depends on the interaction between the hierarchies in (37). Under the simplest interaction (i.e. absolute dominance of one hierarchy over the other), the least marked segment is selected: if the *P/V hierarchy dominates the *NON-HD/V hierarchy, as in (38)a, the optimal epenthetic segment is the most perceptible available vowel; if the *NON-HD/V hierarchy dominates the *P/V hierarchy, as in (38)b, the optimal epenthetic vowel is the least perceptible available vowel. (For the selection of non-corner vowels, see §5.3.)

(38) Interactions between *P/V and *NON-HD/V
   a. *P/V » *NON-HD/V → The best available peak is selected
   b. *NON-HD/V » *P/V → The best available margin is selected

In the case of AC, in order to select [a] as epenthesis the *P/V hierarchy must dominate *NON-HD$_{PWIns}$/V, which especially penalises weak vowels as nuclei in weak prosodic-word positions. The resulting hierarchy is the one presented in (39). Contrariwise, across words, i.e. off the prosodic word, the least sonorous vowel is preferred. In this case, it is sufficient that the constraints that evaluate the presence of vowels in weak prosodic-word-off positions (*NON-HD$_{PWOffs}$/V) dominate the *P/V hierarchy, as shown in (40).

(39) *P/ə » *P/i,u » *P/e,o » *P/ɛ,ɔ » *P/a » *NON-HD$_{PWIns}$/a » *NON-HD$_{PWIns}$/ɛ,ɔ » *NON-HD$_{PWIns}$/e,o » *NON-HD$_{PWIns}$/i,u » *NON-HD$_{PWIns}$/ə

(40) *NON-HD$_{PWOffs}$/a » *NON-HD$_{PWOffs}$/ɛ,ɔ » *NON-HD$_{PWOffs}$/e,o » *NON-HD$_{PWOffs}$/i,u » *NON-HD$_{PWOffs}$/ə » *P/ə » *P/i,u » *P/e,o » *P/ɛ,ɔ » *P/a

Since unstressed mid vowels and [ə] are excluded in AC for other reasons, these two hierarchies can be simplified as ⟦*NON-HD$_{PWOffs}$/a » *NON-HD$_{PWOffs}$/i,u » *P/i,u » *P/a » *NON-HD$_{PWIns}$/a » *NON-HD$_{PWIns}$/i,u⟧.[21] According to this ranking, word epenthesis picks the most sonorous vowel ([a]), even though it is associated to an unstressed position (41)a. The possibility of selecting [i] is excluded by *P/i,u, which penalises low sonority vowels as nuclei (41)b. *NON-HD$_{PWOffs}$/V constraints are irrelevant in this context. (Unlike epenthetic vowels, input vowels would not be affected by *P/V requirements because they are protected by higher-ranked faithfulness IDENT constraints. For the sake of brevity, we ignore this issue here as well as the fact that epenthetic round vowels are banned by *[Labial]; cf. note 16.)

(41)

/véntɾ/ ‘belly’	*NON-HDPWOffs/ V	*P/i,u	*P/a	*NON-HDPWIns/a	*NON-HDPWIns/i,u
☞a. vén.tɾa			*	*	
b. vén.tɾi		*!			*

Across words, the choice of [a] as nucleus is penalised by the high-ranked *NON-HDPWOffs/a constraint (42)a. The vowel [i], which is a worse nucleus in absolute terms, is preferred here because it is more prone to occur in weak positions (42)b. (In this context, the irrelevant constraints are those of the *NON-HDPWIns/V family.)

(42)

/tót tapád/ ‘all (SG) covered’	*NON-HDPWOffs/a	*NON-HDPWOffs/i,u	*P/i,u	*P/a	*NON-HDPWIns/ V
a. tò.ta.ta.pát	*!			***	
☞b. tò.ti.ta.pát		*	*	**	

This approach presents some clear advantages. First of all, parallelism can be maintained. Second, since the selection of the vowels is inferred from a single ranking of constraints, there is no need to appeal to underspecification or phonological (language-specific) markedness. Third, it is predicted that strong and weak positions place different conditions on vowel quality, whether in neutralisation or epenthesis selection, as the facts of western Catalan will next corroborate.

5.3 Further evidence for the parallel prominence-driven approach

Western Catalan shows another interesting case of differences in the selection of the epenthetic vowel, which is further related to significant restrictions on the contrast between /a/ and /e/ in unstressed syllables. In this section we examine this case in the light of prominence, but first we will briefly review the facts of central Catalan, with a single epenthetic vowel, to foresee the overall implications of our proposal.

As said in §2, central Catalan has the three-vowel stressless system [i], [u] and [ə]. It thus follows the prominence reduction pattern according to which less sonorous vowels are well suited to unstresssed positions (cf. Wheeler 2005: §2.3.7 for Catalan, who follows Crosswhite 2004). Central Catalan does not have epenthesis across words, but it does within words for the same syllabic reasons appealed to in §3.1 for AC. In this case, the domain of epenthesis is just the prosodic word and the selected vowel is always [ə] (43).

(43)

espina	/spín-a/	[əs.pí.na]	‘spine’
espaguetis	/spagéti-z/	[əs.pa.ɣé.tis]	‘spaghetti’
Snoopy	/snúpi/	[əz.nú.pi]	‘Snoopy’
sofre	/sófɾ/	[só.frə]	‘sulphur’
ventre	/béntɾ/	[bén.trə]	‘belly’
ventres	/béntɾ-z/	[bén.trəs]	‘bellies’

coneixeré /kunéʃ-ɾé/ [ku.nə.ʃə̲.ɾé] ‘I will know’

As regards vowel selection for epenthesis, central Catalan resorts to the same strategy as AC: it picks the least sonorous, least perceptible segment for the weakest position. However, while AC distinguishes between the weak prosodic-word-off epenthetic site and the strong prosodic-word-in epenthetic site, the only relevant weak position for central Catalan is the epenthetic site, where the least sonorous vowel of its unstressed system is selected as epenthesis (i.e. [ə]). As said in §5.2, the optimal epenthesis is selected when the *NON-HD/V hierarchy dominates the *P/V hierarchy. The difference of central Catalan with respect to AC is that in the former there is no evidence to split the *NON-HD/V hierarchy in constraints relativised to more specific positions. The ranking in (44) is sufficient to account for the facts of central Catalan.

(44) *NON-HD/a » *NON-HD/ɛ,ɔ » *NON-HD/e,o » *NON-HD/i,u » *NON-HD/ə » *P/ə » *P/i,u » *P/e,o » *P/ɛ,ɔ » *P/a

Since in central Catalan mid and low vowels are excluded from stressless positions for other reasons, the ranking in (44) can be simplified as ⟦*NON-HD/i,u » *NON-HD/ə » *P/ə » *P/i,u⟧. The ranking of *NON-HD/i,u above *NON-HD/ə prevents high vowels from being selected as epenthesis (45)b, resulting in the systematic addition of the weakest vowel, i.e. [ə] (45)a.

(45)

/béntɾ/ ‘belly’	*NON-HD/i,u	*NON-HD/ə	*P/ə	*P/i,u
☞a. bén.tɾə̲		*	*	
b. bén.tɾi̲	*!			*

In comparison with the previous dialects, the notable characteristic of vowel reduction in western Catalan is that it displays a five-vowel stressless system: the three corner vowels [i], [u] and [a] plus the half-close mid vowels [e] and [o]. Functional approaches analyse this five-vowel pattern as another instance of contrast-enhancing reduction (cf. Wheeler 2005: §2.3.6 for Catalan, upon Crosswhite 2004). According to this view, some non-corner vowels are banned in unstressed position to keep maximal distinct contrasts without losing too many input differences. Faithfulness IDENT constraints referring to height and colour protect the corner vowels as well as half-close mid vowels. The former are preserved because they are maximally distinctive. The latter, which compete in articulation and perception with half-open mid vowels, are retained because of the preference for low sonority segments in unstressed position.

In western Catalan, the domain of epenthesis is the prosodic word, like in central Catalan, but [a] is selected in initial position —for some speakers, in variation with [e]— (46)a, while [e] is selected in internal and final position —without any variation— (46)b.[22] The examples below are from Valencian Catalan.

(46)	a.	espina	/spín-a/	[a̲s.pí.na]~[e̲s.pí.na]	‘spine’
		espaguetis	/spagéti-z/	[a̲s.pa.ɣé.tis]~[e̲s.pa.ɣé.tis]	‘spaghetti’
		Snoopy	/snúpi/	[a̲z.nú.pi]~[e̲z.nú.pi]	‘Snoopy’
	b.	sofre	/sófr/	[só.fre̲]	‘sulphur’
		ventre	/véntr/	[vén.tre̲]	‘belly’
		ventres	/véntr-z/	[vén.tre̲s]	‘bellies’
		coneixeré	/koné∫-ré/	[ko.nej.∫e̲.ré]	‘I will know’

The difference in vowel selection for initial epenthesis is related to a broader lowering phenomenon that almost systematically changes /e/ into [a] in word-initial unstressed closed syllables in western Catalan (47)a. Moreover, other words with initial onsetless closed syllables that do not show morphological alternations with corresponding stressed syllables also show predominantly [a], and not [e], in this position (47)b. Overall, word-initially, in stressless closed syllables the [a]/[e] contrast is usually lost in favour of [a] (which is more sonorous than [e]).

(47)	a.	emprar	[am.prár]~[em.prár]	‘to use’	(cf. empres [ém.pres] ‘you use’)
		entrar	[an.trár]~[en.trár]	‘to come in’	(cf. entres [én.tres] ‘you come in’)
	b.	embut	[am.bút]~[em.bút]	‘funnel’	
		eixam	[aj.∫ám]~[ej.∫ám]	‘swarm’	

Remarkably, this lowering phenomenon occurs in the variety of Catalan that further shows systematic raising of /a/ to [e] word-finally in unstressed closed syllables, as shown by the alternations in (48).[23] Hence, in this position the [a]/[e] contrast is lost in favour of [e] (which is less sonorous than [a]).

(48)	a.	casa	[káza]	cases	[kázes]		‘house/ houses’
		(where [a]/[e] are instances of the /a/ feminine marker)					
	b.	canta	[kánta]	cantes	[kántes]	canten [kánten]	‘(s)he/you/they sing’
		(where [a]/[e] are instances of the /a/ verbal ending)					

Our view is that the prominence-driven approach we have put forth can straightforwardly explain vowel selection for epenthesis in western Catalan as well as the related lowering and raising effects. As for epenthesis, [a] is usually chosen word-initially, i.e. in a relatively strong prosodic position, where the most sonorous vowel is favoured, while [e] is chosen in internal and word-final position, i.e. in weak prosodic positions, where less sonorous vowels are favoured instead.[24] The former situation is similar to that encountered in AC with respect to word [a]-epenthesis, with the proviso that now the most perceptible marginal position does not include all prosodic-word-in sites, but only those in the most prominent unstressed position, i.e. word-initially. Hence, the *NON-HD/V family is relativised with respect to this prosodic position, *NON-HD$_{\text{PWIn(itial)}}$/V, and the *P/V

family dominates *NON-HD$_{PWIn}$/V (49), just as *P/V dominates *NON-HD$_{PWIns}$/V in AC (cf. (39)). With this ranking, in word-initial position [a] is selected as epenthesis because it is the segment that minimally violates the constraints of the *P/V family (50).[25]

(49) *P/ə » *P/i,u » *P/e,o » *P/ɛ,ɔ » *P/a » *NON-HD$_{PWIn}$/a » *NON-HD$_{PWIn}$/ɛ,ɔ » *NON-HD$_{PWIn}$/e,o » *NON-HD$_{PWIn}$/i,u » *NON-HD$_{PWIn}$/ə

(50)

/spín-a/ ‘spine’	*P/i,u	*P/e,o	*P/a	*NON-HD$_{PWIn}$/a	*NON-HD$_{PWIn}$/e,o
☞a. as.pí.na	*		**	*	
b. es.pí.na	*	*!	*		*
c. is.pí.na	**!		*		

In addition to that, some of the constraints that penalise the occurrence of sonorous segments in the weakest position within the word, i.e. the *NON-HD$_{PWNon\text{-}In(itial)}$/V family of constraints, are ranked higher in the hierarchy to favour the selection of less sonorous vowels as epenthesis. In particular, *P/e,o must be dominated by *NON-HD$_{PWNon\text{-}In}$/a (51). When an epenthetic vowel is added in a word position that is not initial, *NON-HD$_{PWNon\text{-}In}$/a discards the candidate with [a] (52)a, in favour of the one with [e], which violates the lower-ranked constraint *P/e,o (52)b.[26] As in (50)c, the candidate with [i] is eliminated by the highly ranked constraint *P/i,u (52)c.

(51) *P/ə » *P/i,u » *NON-HD$_{PWNon\text{-}In}$/a » *P/e,o » *P/ɛ,ɔ » *P/a » *NON-HD$_{PWNon\text{-}In}$/ɛ,ɔ » *NON-HD$_{PWNon\text{-}In}$/e,o » *NON-HD$_{PWNon\text{-}In}$/i,u » *NON-HD$_{PWNon\text{-}In}$/ə

(52)

/véntɾ/ ‘belly’	*P/i,u	*NON-HD$_{PWNon\text{-}In}$/a	*P/e,o	*P/a	*NON-HD$_{PWNon\text{-}In}$/e,o
a. vén.tɾa		*!	*	*	
☞b. vén.tɾe			**		*
c. vén.tɾi	*!		*		

Along the same lines, in stressless lexical positions the effects of contrast-enhancing reduction overlap with those of prominence-driven reduction. In this case, word-initially, i.e. in a strong prosodic position, [a] is more prone to occur in closed syllables (e.g. *emprar* [am.pɾáɾ] ‘to use’), while word-finally, i.e. in a weak prosodic position, [e] is more prone to occur in closed syllables (e.g. *cases* [ká.zes] ‘houses’). In both cases, the [a]/[e] contrast is lost in the worst context, i.e. unstressed closed syllables, to improve distinctiveness, minimal acoustic ambiguity among vowels.

6 Levels, vowel selection and voice neutralisation

6.1 A serial approach to vowel selection and the case of voice neutralisation

An alternative to the present approach as regards vowel-epenthesis selection that requires special attention is one based on stratal OT. Under the view that some constraints can be reranked at different strata, the AC data can be analysed as showing the ranking *P/V » *NON-HD/V at the (prosodic) word level, where [a] is selected as epenthesis, but the ranking *NON-HD/V » *P/V at the phrasal level, where [i] is selected as epenthesis across words.

A well-known argument given in the literature to support stratal OT comes from the facts of Catalan concerning voice neutralisation among obstruents (e.g. Bermúdez-Otero 2001, 2006). The data are as follows. Within words, obstruents contrast in voice in onset position, but devoicing applies word-finally (53). (The examples are from AC, unless otherwise specified.)

(53)	cas	[kás]	'case'	Cf. [ká.zus] 'cases'
	pas	[pás]	'step'	Cf. [pá.sa] 's/he passes'
	desig	[da.zít͡ʃ]	'desire'	Cf. [da.zi.d͡ʒá] 'to desire'
	despatx	[das.pát͡ʃ]	'dismissal'	Cf. [das.pa.t͡ʃát] 'dismissed'
	apassionat	[a.pa.sju.nát]	'passionate (MASC)'	Cf. [a.pa.sju.ná.ɾa] 'passionate (FEM)'[27]
	petit	[pa.tít]	'small (MASC)'	Cf. [pa.tí.ta] 'small (FEM)'

Across words, except in some western varieties, Catalan shows a sibilant voicing phenomenon according to which voice spreads from a word-initial vowel to a preceding sibilant, whether fricative (e.g. *pa*[z] *enrere* 'backwards step', *pa*[z] *especial* 'special step') or affricate (e.g. *desi*[d͡ʒ] *apassionat* 'passionate desire', *desi*[d͡ʒ] *especial* 'special desire'). This phenomenon does not affect stops and *f*.[28] In AC, though, voicing only applies in the case of sibilant fricatives; that is, sibilant fricatives voice preceded by a word-initial vowel, whether epenthetic or not (54)a, but sibilant affricates (54)b never voice (nor do stops and *f* (54)c) (cf. Bosch 2002: 142).

(54)	a.	pas enrere	[pà.z an.ré.ɾa]	'backwards step'	Cf. pas [pás]
		pas especial	[pà.z a̲s.pe.sjál]	'special step'	Cf. especial /spesjál/
	b.	desig apassionat	[da.zì.t͡ʃ a.pa.sju.nát]	'passionate desire'	Cf. desig [da.zít͡ʃ]
		desig especial	[da.zì.t͡ʃ a̲s.pe.sjál]	'special desire'	
		desig bo	[da.zì.t͡ʃ i̲. bɔ́]	'nice desire'	
		lo temps és bo	[lu. tèn.t͡s ez. bɔ́]	'the weather is nice'	Cf. temps [tén͡ts]
		temps especial	[tèn.t͡s a̲s.pe.sjál]	'special weather'	
		temps bo	[tèn.t͡s i̲. bɔ́]	'nice weather'	
	c.	bec aigua	[be.k ál.gwa]	'I drink water'	Cf. bec [bék]
		arrib ara	[a.ri.p á.ɾa]	'I'm arriving now'	Cf. arrib [a.ríp]

escriv ara [a̲s.kɾi.f á.ɾa] ‘I’m writing now’ Cf. escriv [a̲s.kɾíf]

Lastly, a coda obstruent assimilates in voice to a following consonant, both within words (55)a and across words (55)b, in all Catalan varieties. As for AC, intervening [i] epenthetic vowels block assimilation (55)c, just as any other vowel does (55)d.

(55)	a.	especial	[a̲s.pe.sjál]	‘special’
		mesquí	[mas.kí]	‘mean’
		esmorzar	[a̲z.mul.d͡zá]	‘to have breakfast’
		asmàtic	[az.má.tik]	‘asthmatic’
	b.	pas petit	[pàs. pa.tít]	‘small step’
		cas perdut	[kàs. pal.dút]	‘lost case’
		pas gran	[paz. gɾán]	‘big step’
		cas mesquí	[kàz. mas.kí]	‘mean case’
	c.	arrib bé	[a.rì.p i̲. bé]	‘I’m arriving well’
		temps bo	[tèn.t͡s i̲. bɔ́]	‘nice weather’
		desig mesquí	[da.zì.t͡ʃ i̲. mas.kí]	‘mean desire’
	d.	arrib avui	[a.rì.p a.vwí]	‘I’m arriving today’
		desig aguardat	[da.zì.t͡ʃ a.gwal.dát]	‘expected desire’
		bic esmolat	[bì.k a̲z.mu.ɾát]	‘sharp beak’
		desig esballat	[da.zì.t͡ʃ a̲z.ba.ʎát]	‘wrong desire’

As noted by previous authors regarding the general facts of Catalan (cf., e.g., Mascaró 1987, Jiménez 1997, Bonet & Lloret 1998, Bermúdez-Otero 2001, Wheeler 2005), sibilant voicing (sibilant fricative voicing in the case of AC) poses a serious problem to rule-based analyses, because voicing does not affect all onset sibilants but only those in word-final position, which are resyllabified as onsets (e.g. *passa* /pása/, [pá.sa], *[pá.za] vs. *pas enrere* [pà.z an.ré.ɾa], *[pà.s an.ré.ɾa]). Hence, the sibilant voicing rule has to take into account word boundaries although it is a phrasal phenomenon. This situation does not well fit the tenets of derivational phonology, according to which inputs of each new level are blind to boundaries. Mascaró (1987) offers a solution grounded on underspecification within a rule-based autosegmental account: coda obstruents lose their laryngeal node at the word level; delaryngealised obstruents are then supplied with voicing by assimilation rules at the phrasal level, with [–voice] assigned by default in the absence of an assimilatory environment. (On the use of [voice] as a binary feature, see Wetzels & Mascaró 2001.)

This two-step solution is recasted in stratal OT by Bermúdez-Otero (2001, 2006), within a licensing-by-cue view of voicing (cf., e.g., Steriade 1999). According to Bermúdez-Otero (2001), delaryngealisation at the word level is accomplished by ranking LICENSE(LARYNGEAL) (‘A laryngeal node must not be licensed by a root node syllabified in the coda’, p. 43), above IDENT(LARYNGEAL) and OBSTRUENT → LARYNGEAL (‘If a segment is [–sonorant], then it must possess a laryngeal node’, p. 44). At the phrasal level, however, LICENSE(LARYNGEAL) is crucially demoted, with OBSTRUENT → LARYNGEAL top-ranked in

the hierarchy. In this situation, the specific value of [±voice] is determined by the following ranking of constraints: (phrasal level) OBSTRUENT → LARYNGEAL » ONSETIDENT(LARYNGEAL) » *CONTVOICELAG » NO-VC-LINK » LICENSE(LARYNGEAL). ONSETIDENT(LARYNGEAL) protects voice-specified onsets; it does not affect codas resyllabified as onsets because they have been delaryngealised at the word level. NO-VC-LINK ('A laryngeal node must not be simultaneously dominated by a vowel and an obstruent', p. 53; *apud* Itô *et al.* 1995: 600, and specifically applied to Catalan sibilant voicing by Jiménez 1997) prevents the sharing of voice specifications between dissimilar segments, but *CONTVOICELAG ('*[$_{[+cont]}$ ... [$_{[+voice]}$', p. 52) determines leftward spreading of [+voice] to a preceding [+cont] segment (which in the case of AC would only affect sibilant fricatives).[29] Hence, at the phrasal level, sibilants (sibilant fricatives in AC) voice to satisfy *CONTVOICELAG (e.g. *pas enrere* [pà.z an.ré.ɾa], *cus ara* [ku.z á.ɾa], as well as *pas especial* [pà.z a̲s.pe.sjál] with word-level [a]-epenthesis), whereas stops do not voice to satisfy NO-VC-LINK (e.g. *arrib ara* [a.ri.p á. ɾa], *bic esmolat* [bì.k a̲z.mu.ɾát]). All preconsonantal coda obstruents assimilate voice from the following consonant to satisfy LICENSE(LARYNGEAL) (e.g. *especial* [a̲s.pe.sjál], *esvariar* [a̲z.va.ɾi.á]; *pas petit* [pàs. pa.tít], *pas gran* [paz. gɾán]).

The previous analysis raises some controversial issues. It predicts, for example, that laryngeal underspecification is a possible surface pattern for coda obstruents, an arguable issue to which Bermúdez-Otero (2001: 59) gives support by appealing to work by Hsu (1996) on Taiwanese, where it is reported that neutralised obstruents are phonetically targetless and become voiced or voiceless through phonetic interpolation. The analysis also resorts to the debatable issue of having to specify directionality for certain agreements (i.e. the leftward span established by *CONTVOICELAG).

Given the contexts needed for expression of voice in Catalan (including AC), we argue instead —in line with Jiménez (1997), Beckman (1998: §1.3), Wheeler (2005) and Beckman & Ringen (2007)— that the prosodic approach to voicing (Lombardi 1996, 1999, 2001, Beckman 1998) better accounts for these facts.[30] We further claim that voice assimilation among consonants and between a consonant and a vowel is due to the same driving force, ruled by AGREE-type constraints, which finds a suitable formalisation within parallel OT.

6.2 Voice neutralisation under parallel OT

It is a well-known fact that assimilations usually take place from prominent to weak positions. In other words, prosodically strong elements tend to trigger assimilation, whereas prosodically weak elements tend to be the targets of assimilation, or are neutral with respect to it. Voice assimilation between consonants follows this pattern, since in sequences like *és bo* 'it is good' the spread takes place from onset to coda ([ez. bɔ́]), and not from coda to onset (*[es. pɔ́]) (cf. Jiménez 1997, Beckman 1998, Bermúdez-Otero 2001, Wheeler 2005, Beckman & Ringen 2007). Our claim is that voice assimilation across words also follows the typical pattern of spreading from strong to weak positions, now being strong prosodic-word initial position and weak prosodic-word final position. These facts can be captured by the interaction of the general constraint AGREE[±voice] presented in (56), which favours voicing coincidence between an obstruent and a following segment (whether it is a nucleus

vowel, an onset consonant or a consonant in a complex coda), with a more specific constraint based on the differences in prominence between the initial and the final position of the prosodic word (57). The constraint AGREE[±voice]$_{PW}$ is ranked above AGREE[±voice], which is consistent with the fact that word-final consonants, whose value for [±voice] ends up not being distinctive, are more likely to be assimilated.[31]

(56) AGREE[±voice]: An obstruent and a following segment must agree in voicing.
(57) AGREE[±voice]$_{PW}$: An obstruent and a following word-initial segment must agree in voicing.

Voice assimilation from word-initial vowels to previous (word-final) obstruents is limited by the role of NO-LINK-VC, applying to the sonority distance of sibilant fricatives in AC (58) (and to the greater sonority distance of sibilants including affricates in other dialects of Catalan). Voiced obstruents are penalised by the markedness constraint in (59). Voice features are protected by the general input-output constraint IDENT[±voice] (60) and, more specifically, onset features are protected by the positional faithfulness constraint IDENT[±voice]$_{Onset}$ (61). The voiceless character of word-final non-sibilant fricatives (non-sibilants in other dialects) when they are followed by a word-initial vowel is an effect of the output-output faithfulness constraint OO-IDENT[±voice] (62), which enforces corresponding voicing between the realisation of words in isolation and that in a phonological phrase (cf. Lombardi 1996, applied to Catalan by Wheeler 2005: §5.4). The interaction of these constraints with the two AGREE[±voice] constraints formulated above accounts for the AC facts with the ranking provided in (63).

(58) NO-LINK-VC: Avoid the linkage of [±voice] between vowels and O (i.e stops, affricates and *f*) (*apud* Itô *et al.* 1995: 600; cf. Jiménez 1997, Bermúdez-Otero 2001, for Catalan).
(59) *[+voice, –son]: Obstruents are not voiced.
(60) IDENT[±voice]: The value for [±voice] in the input is the same of its correspondent in the output.
(61) IDENT[±voice]$_{Onset}$: The value for [±voice] in the input is the same of its correspondent in the output, if it is syllabified as an onset.
(62) OO-IDENT[±voice]: The value for [±voice] in a prosodic word is the same of its correspondent in a phonological phrase. (IDENTWd-Phr[±voice] in Wheeler 2005)
(63) Ranking: NO-LINK-VC » AGREE[±voice]$_{PW}$ » OO-IDENT[±voice] » IDENT[±voice]$_{Onset}$ » AGREE[±voice] » *[+voice, –son] » IDENT[±voice]

The tableau in (64) exemplifies the analysis of voice features within the prosodic word. The optimal candidate, (64)a, devoices the final obstruent, which shows that *[+voice, –son] outranks IDENT[±voice] (cf. (64)d). In (64)a the consonant cluster shares the [+voice] feature, and thus incurs a violation mark from *[+voice, –son]. Since candidate (64)c fully satisfies *[+voice, –son], AGREE[±voice] must dominate *[+voice, –son] to discard it. In (64)b the last sibilant assimilates [+voice] from the following vowel to satisfy AGREE[±voice], an outcome ruled out by IDENT[±voice]$_{Ons}$. (As noted in §3.1, independent constraints account for word-initial epenthesis in these cases.)

(64)

/smusád/ ‘softed’	NO-LINK-VC	AGREE [±vc]$_{PW}$	OO-ID [±vc]	ID [±vc]$_{Ons}$	AGREE [±vc]	*[+vc, –son]	ID [±vc]
☞a. [az.mu.sát]					*	*	**
b. [az.mu.zát]				*!		**	***
c. [as.mu.sát]					*!*		*
d. [az.mu.sád]					*	**!	*

Across words, the constraint responsible for voice assimilation is AGREE[±voice]$_{PW}$. When a word-final obstruent is followed by another consonant, the optimal candidate assimilates voice from the word-initial consonant to satisfy AGREE[±voice]$_{PW}$, in violation of OO-IDENT[±voice] (cf. (65)a); hence, AGREE[±voice]$_{PW}$ outranks OO-IDENT[±voice] (cf. (65)b). In (65)c the onset consonant assimilates [–voice] from the word-final consonant. This candidate fares even with the winning candidate regarding AGREE[±voice]$_{PW}$ and OO-IDENT[±voice], but it incurs a fatal violation mark from the lower-ranked IDENT[±voice]$_{Ons}$ constraint.

(65)

/káz bɔ́/ ‘good case’ *Bases*: [kás], [bɔ́]	NO-LINK-VC	AGREE [±vc]$_{PW}$	OO-ID [±vc]	ID [±vc]$_{Ons}$	AGREE [±vc]	*[+vc, –son]	ID [±vc]
☞a. [kaz.bɔ́]			*		*	**	
b. [kas.bɔ́]		*!			**	*	*
c. [kas.pɔ́]			*	*!	**		**

Likewise, sibilant fricative voicing applies before vowels, even if the following vowel is [a]-epenthesis, as in (66). Here, voice assimilation takes place because the relevant vowel appears at the beginning of the prosodic word, a prominent position with respect to word-final position, and thus OO-IDENT[±voice] becomes irrelevant (66)a. (The same result is obtained with word-initial underlying vowels.)[32]

(66)

/káz spesiál/ ‘special case’ *Bases*: [kás], [aspesjál]	NO-LINK-VC	AGREE [±vc]$_{PW}$	OO-ID [±vc]	ID [±vc]$_{Ons}$	AGREE [±vc]	*[+vc, –son]	ID [±vc]
☞a. [kà.zas.pe.sjál]			*		***	*	
b. [kà.sas.pe.sjál]		*!		*	****		*

In contrast, when the first word ends in an O (i.e. stops, affricates or *f*), the outcome with assimilation to the following vowel (assimilation being indicated with identical subscripts in (67)a) is discarded by the constraint NO-LINK-VC ranked at the top of the hierarchy, crucially above AGREE[±voice]$_{PW}$. A remark is in order with respect to candidate (67)c: the word-final obstruent and the word-initial vowel have their own voice specification (indicated with different subscripts in (67)c). We assume, as it is usually done in OT work, that this representation violates the AGREE-type constraints, because the two

segments do not share the voice feature.[33] Hence, since (67)b as well as (67)c violate AGREE[±voice]$_{PW}$, the ranking selects the outcome that respects next constraint in the hierarchy, (67)b, showing that OO-IDENT[±voice] outranks IDENT[±voice]$_{Ons}$. (The same result is obtained with word-initial epenthetic vowels, whether [a] or [i].)

(67)

/aríb ára/ 'I'm arriving now' *Bases*: [a.ríp], [ára]	NO-LINK-VC	AGREE [±vc]$_{PW}$	OO-ID [±vc]	ID [±vc]$_{Ons}$	AGREE [±vc]	*[+vc, –son]	ID [±vc]
a. [a.ri.b$_i$á$_i$.ɾa]	*!		*			*	
☞b. [a.ri.p$_i$á$_j$.ɾa]		*		*	*		*
c. [a.ri.b$_i$á$_j$.ɾa]		*	*!		*	*	

7 Conclusions

The leading idea of this study is that differences in the selection of the epenthetic vowel in languages with more than one epenthetic vowel quality can be determined by prominence associated to the vowel-sonority hierarchy (cf. de Lacy 2002). We have broadened the empirical basis with data from Catalan and, accordingly, we have enriched the formal machinery with an extension of the head/non-head categories to additional structural positions in and off the prosodic word. The well-known claim that high sonority vowels are preferred in more prominent positions and low sonority ones are favoured in less prominent positions finds striking support in AC (with [a]-epenthesis in the prosodic word and [i] off the prosodic word), as well as in western Catalan (with [a]-epenthesis in word-initial position, and [e] word-internally and word-finally). These prominence-sensitive patterns match the usual types of vowel reduction (cf. Crosswhite 1999, 2004). Additionally, it has been proved that they conform to other position-sensitive vowel neutralisations that western Catalan shows (with a preference for [a] in unstressed word-initial closed syllables, but [e] in unstressed word-final closed syllables). Lastly, it has been shown that prominence is also at issue when dealing with the facts of voice neutralisation among obstruents in Catalan.

We have made use of the notion of weak cues to justify the context of vowel insertion across words in AC, which is triggered by consonant clusters (except 'glide+*s*', 'glide+nasal') and stops, affricates and *f* in the worst perceptual position, i.e. in preconsonantal codas. Pulling back even further to the main goals of the study, we have suggested that this perceptual explanation matches the sonority-based complexity ranking proposed in Clements (1990) regarding sonority distance and dispersion between the members of demisyllables. Differences in sonority distance have been used in this paper to account for sibilant voicing across words in prevocalic contexts in Catalan (limited to sibilant fricatives in AC), following the argument that segments that are more distant are less prone to assimilate (cf. Itô *et al.* 1995). Something that bears highlighting is that, in AC, the simple-coda obstruents that do not trigger vowel epenthesis across words are the same that undergo voice assimilation from a following vowel across words, i.e. sibilant fricatives. In our view, this coincidence derives from the location of sibilant fricatives higher than other obstruents in the sonority scale: the relatively prominent character of sibilant fricatives guarantees sufficient perceptual cues for them to survive as

preconsonantal codas and, at the same time, their more vowel-like nature permits them to interact (i.e. to share features) with vowels.

Overall, the simplicity and breadth of coverage of our proposal suggest that we might be on the right track of understanding the conjoint gestural and perceptual work of prominence, sonority and distance.

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Notes

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[1] In the examples, several cases illustrate coda obstruent voice assimilation and word-final obstruent devoicing, two general phenomena that apply without exceptions in Catalan (cf. §6). The item *porc* [pɔ́lk] illustrates the rC to lC change, which is specific to AC (see note 8 too). The AC data are mainly from Loporcaro (1997) and the *Corpus Oral Dialectal* (COD) of the University of Barcelona (http://www.ub.edu/lincat). Other sources used are Recasens (1991), Bosch (2002) and Scala (2003), with additional data from Andreu Bosch and Luca Scala (personal communications).

[2] On the underlying voiced character of the plural morph /z/, see, e.g., Mascaró (1986: 87).

[3] Wheeler (2005: §9.4) adduces an additional piece of evidence for the epenthetic nature of these initial vowels from the stress pattern of verbs like *estar* 'to be', which fits his analysis if a root /st/, and not /Vst/, is posited. (See Alderete 1995 for a similar analysis on the stress pattern of *estar* in Spanish.)

[4] Wheeler (2005: 252) resorts to CONTIGUITY to ban deletion or epenthesis within morphs (cf. Kenstowicz 1994, McCarthy & Prince 1995). The idea is that if we consider word bases such as /área/ and /trákea/, internal [e] would be protected by I-CONTIGUITY but not edge-[a]. The use of this constraint does not solve all the problems though, since I-CONTIGUITY would be satisfied if both vowels were eliminated (e.g. **traqueaïtis*). We do not examine this word-based approach further here.

[5] Another phonological difference between nouns and verbs involves, for instance, the deletion/maintenance of some final consonants, which are kept in certain verbal forms but are otherwise deleted in the language. Compare, for example, *coman* 'I order' versus *mà* 'hand' (from the underlying form /mán/, cf. *mans* 'hands'). Other non-1st person-singular verbal forms of the present indicative paradigm show the same difference, e.g. *entén* 's/he understands' in all Catalan dialects. Loporcaro's (1997) analysis heavily depends on the 1st person-singular verbal forms with sonority violations to deny word epenthesis in AC, without taking into account all other different phenomena that the verbal forms show with respect to the nominal ones. He further adduces the existence of the adjectival masculine singular form *alegre* 'happy', with the attested pronunciation [a.lékr] (reduced to [a.lék] in casual speech), but [a.l͡éts] always in the plural, with cluster simplification and place assimilation (cf. Scala 2003: 36). This is, however, the only instance of nominal inflection

with a sonority violation. In our view, this example shows the initial stadium of a change, but it is not nowadays representative enough to deny word epenthesis in AC for the aforementioned adduced reasons (cf. Lloret 2004b).

[6] The study of the specific sonority-related conditions that hold for AC, i.e. the ones fixing the grade of sonority distance allowed tauto- and hetero-syllabically, falls out of the aim of this paper. Full discussion on this topic for Catalan appears in Wheeler (2005: §3.1, §8). Wheeler does not deal with AC but his approach can extend to the AC data, especially the generalisations and analysis he proposes for the other insular dialect, i.e. Balearic Catalan, with which AC shares many phonotactic restrictions, except the one related to [i]-epenthesis (on the role of sonority in Balearic Catalan, see also Pons 2004, who follows Gouskova's 2004 proposal on relational alignment hierarchies). For an OT approach to the cases involving OCP among sibilants and its interaction with epenthesis, see Bonet & Lloret (2002).

[7] For the purposes of this paper, we limit the use of MAX and DEP to consonants and vowels, respectively. MAX-V interacts with deletion of vowels in word contacts (e.g. *compra atraços* [kòm.pra.trá.sus] 's/he buys tools'), an issue with which we do not deal here. On the ranking of DEP-C with respect to DEP-V, see note 14.

[8] The examples in (16) illustrate other phenomena that are specific to the AC phonology, which will not be analysed in this paper: the occurrence of an intrusive stop between *l/n* and *s*, yielding an affricate (e.g. *animals* [a.ni.mál͡ts] 'animals', (16)a); *l/d* rhotacism in word-internal intervocalic position (e.g. *malanada* [ma.ɾa.ná.ɾa], (16)e), and *l* to *r* change in complex onsets (e.g. [pɾa.jé], (16)c), with Cl in the other Catalan dialects (e.g. *plaer*). In addition to that, AC shows word-final *r* deletion in most oxytones (e.g. *fer un praier* [fè wm. pɾa.jé], (16)c), which, except for Valencian, is a general fact of Catalan. (See note 1 too.)

[9] The word *pouc* is the only instance of GO codas in AC and it is usually pronounced reduced: [púk]. Other cases of [uw] simplification in other Catalan varieties are *duu* [dúw]~[dú] 's/he brings', *duus* [dúws]~[dús] 'you bring'. (See note 13.)

[10] One could conceivably go on regarding this problem as being an effect of syllable contact by assuming that the violation of the syllable contact law is more penalised for certain consonants than for others. This is just another way to acknowledge that the facts are related to the nature of the coda consonant and not to the contact itself.

[11] The complexity of movements of articulators contributing to the perceptual effect of sonority has been argued for, among others, by Dziubalska-Kolaczyk (2002, 2003) within the phonotactics model of Beats-and-Binding (Natural) Phonology. For independent reasons, Wheeler (2005: 254) points out not only the complex phonetic nature of affricates but also their complex phonological behaviour in Catalan.

[12] Wright (2004) provides support for recasting phonotactic constraints, including SONORITYSEQUENCE, on the basis of perceptual cue robustness. As for preferred segmental sequences, he distinguishes sibilant fricatives from the other fricatives because sibilant fricatives have reliable cues at their peaks of stricture, and thus are more likely to survive without flanking vowels. As expected, preconsonantal coda consonants are in a poorer situation than their word-final counterparts with respect to perceptibility.

[13] The absence or low frequency of these combinations is related to constraints regarding the dispersion of sonority among the members of a syllable (cf. Wheeler 2005: §8.3).

[14] In (10) we restricted DEP to vowels to prevent consonant insertion to repair onsetless syllables: DEP for consonants is highly ranked in Catalan, while DEP for vowels is ranked very low.

[15] Alignment constraints would not do the right job here since both [vð.la̲s. fé] and [vðl.t͡s i̲. fé] violate the alignment between morphs, due to vowel insertion in the former and to affrication in the latter: the word-epenthetic vowel, [a], misaligns the morphs [vɔl] and [s] in [vð.la̲s. fé] and the closure/stop component of the affricate also misaligns them in [vðl.t͡s i̲. fé].

[16] As pointed out by de Lacy (2002: §4.4.1.4), there is no evidence that the sonority scale distinguishes round and unround vowels, but the emergent influence of *[Labial] (*[+round] in his analysis) will always result in an epenthetic unround vowel because epenthetic elements do not have input features to be faithful to. Catalan illustrates another interesting issue raised by de Lacy, i.e. the fact that an apparently-epenthetic round vowel appears in a morphologically restricted environment, being more plausibly a morpheme than a true default. All Catalan varieties use *o* ([u] in dialects with vowel reduction like AC) to avoid sequences of sibilants in masculine nominals (e.g. *pas* [pás] 'step (MASC)', *passos* [pá.sus] 'steps (MASC)'). Although the pattern is phonologically conditioned, the repair is morphological, since *o* is a marked masculine gender allomorph (for an OT analysis of such cases, see Bonet *et al.* 2007).

[17] Note that if we use other contrasts to end up with [i] as the least marked vowel, the problem of the concurrent presence of the two vowels still persists.

[18] One could assume that the epenthetic [i] only contains a Root node, which would block regressive voice spreading from a following consonant. We do not pursue this line of reasoning for considering it too arbitrary.

[19] Shipibo has left-aligned trochaic feet. Since the quality of the epenthetic vowel depends on its position within the foot, foot-form constraints must dominate the sonority constraints. The fact that the non-head position does not select the least sonorous available vowel of the Shipibo system is accounted for by the constraint penalising the least sonorous vowel, [ɨ], as nucleus (de Lacy 2002: 158).

[20] We include the unmarked segments of each class in each hierarchy (i.e. *P/a for nuclei, *NON-HD/ə for margins), although the same results are accomplished by excluding them from their respective hierarchies, as proposed by Kiparsky (1994) and Gouskova (2003), among others. If we exclude the unmarked segments, in cases such as (41) we eradicate the redundancy related to the fact that the effects of the lowest-ranked constraint in the dominant hierarchy (*P/a) coincide with those enhanced by the highest-ranked constraint of the dominated hierarchy (*$\text{NON-HD}_{\text{PWIns}}$/a). In contrast, the inclusion of all segments in each hierarchy allows the use of the same hierarchy of constraints always, without having to take into account the specific unstressed vowel system of each language. For easiness, we do not use multiple conflation among constraints of a hierarchy (de Lacy 2002, 2004). These points are not crucial to the overall argument of the paper.

[21] The relation of the two *NON-HD/V families with respect to *P/V anticipates, by transitivity, that *NON-HD$_{PWOffs}$/V dominates *NON-HD$_{PWIns}$/V, a predictable ordering given that vowels are prototypically associated to more prominent positions.

[22] Traditionally, [a] was the only possible outcome in word-initial position. Nowadays, however, [a] is being substituted by [e] for independent reasons, e.g. the pressure of the written language (orthographically, <e>) and the influence of Spanish (with [e] in all these cases) (cf. Jiménez 2002). Here we analyse the traditional solution. (In notes 25 and 26, we briefly discuss how the [a]~[e] variation can be formalised.)

[23] Stressless vowels in internal closed syllables only occur pretonically, since Catalan, like Spanish, does not have proparoxytones with the penultimate syllable closed. In this position, the [a]/[e] contrast is usually maintained, although in certain varieties there is a tendency to drop the contrast in favour of [a], whether the syllable is open or closed; e.g. *elegant* [a.la.ɣánt] 'elegant', *calendari* [ka.lan.dá.ri] 'calendar', *Vicenteta* [vi.san.té.ta] (feminine proper name, diminutive; cf. *Vicent* [vi.sén̪t] 'Vincent') (cf. Jiménez 2002).

[24] It is of interest that, in some varieties of Valencian, the verbs *omplir* 'to fill' and *obrir* 'to open' maintain the half-open mid vowel /ɔ/ that appears in the stem not only in stressed position (cf. *obris* [ɔ́.βɾis] 'you open', *omplis* [ɔ́m.plis] 'you fill') but also in unstressed position (cf. *obrim* [ɔ.βɾím] 'we open', *omplim* [ɔm.plím] 'we fill') (cf. Sancho Cremades 1995: 40). The lack of reduction in these unstressed syllables, which never occurs in non-absolute initial syllables (cf. *porta* [pɔ́ɾ.ta] 's/he brings', *portem* [poɾ.tém], *[pɔɾ.tém] 'we bring'), is another instance of the preference for more sonorous vowels in stronger positions.

[25] As said in note 22, [a]~[e] variation is independently motivated. This pattern can be derived if *NON-HD$_{PWIn}$/a is located higher in the ranking, in the same position that *P/e,o appears. With this ranking, the [a]-candidate and the [e]-candidate are optimal, depending upon whether *NON-HD$_{PWIn}$/a dominates *P/e,o or whether *P/e,o dominates *NON-HD$_{PWIn}$/a at any given evaluation.

[26] If *NON-HD$_{PWIn}$/a were ranked just above *P/e,o in (49), the vowel [e] would also be selected in initial position.

[27] As said in note 8, intervocalic /d/ becomes [ɾ] in AC, but it becomes [ð] or deletes in other Catalan dialects.

[28] In Catalan, the facts concerning word-final *f* are not systematic with respect to voicing in prevocalic position, but the general tendency of all dialects is not to undergo voicing (Recasens 1991: 196). Wheeler (2005) takes this view. Our data confirm the voiceless pronunciation in AC.

[29] Bermúdez-Otero (2001, 2006) takes the view (although admittedly controversial) that word-final *f* becomes voiced in prevocalic position. He also discusses the interaction between voice neutralisation and spirantisation of voiced stops. We disregard this issue here because AC, unlike other Catalan dialects, does not show spirantisation.

[30] Beckman (1998: §1.3) and Beckman & Ringen (2007) apply the licensing-by-prosody view to Catalan voice neutralisation (the latter resorting to stratal OT), but they do not

analyse sibilant voicing across words. Jiménez (1997) also applies this view to Catalan within stratal OT and Wheeler (2005: §5) within parallel OT. None of the previous analyses deals with the AC data.

[31] Wheeler (2005: §5.4) needs a specific version of AGREE[±voice], limited to coda obstruents ('A coda obstruent and a following segment must agree in voicing', p. 161), because in his analysis this constraint appears top-ranked in the hierarchy, and hence positional faithfulness constraints (e.g. IDENT[±voice]$_{Onset}$, cf. (61)) cannot restrict its effects adequately. Regarding sibilant voicing across words, Wheeler (2005: §5.5) resorts to LAZYSIBILANTS ('Word-final sibilants are voiced before a vowel', p. 163), unranked with respect to AGREE[±voice]. He relates sibilant voicing to the fact that onset voiced stops preceded by a non-continuant segment are also spirantised in most dialects of Catalan. In AC, though, sibilant fricatives voice across words despite the fact that voiced stops do not spirantise.

[32] The devoicing of word-initial vowels as a strategy to satisfy AGREE[±voice]$_{PW}$ (e.g. *[kà.s ḁs.pe.sjál], *[a.ri.p ḁ́.ra]) is excluded by the marked character of voiceless vowels, which are banned in Catalan.

[33] For the purposes of the analysis presented here, it is enough to assume that OCP causes identical adjacent autosegments to merge. Recent reviews to the analysis of assimilation within OT are, e.g., McCarthy (2004), Archangeli & Pulleyblank (2007) and Baković (2007).