Cluster Reduction: Deletion or Coalescence?*

(accepted for publication in *Catalan Journal of Linguistics*, volume 4 (2005) Special issue on "Morphology in phonology" edited by Jesús Jiménez and Maria-Rosa Lloret)

Max W. Wheeler
Department of Linguistics & English Language
University of Sussex
Falmer, BRIGHTON BN1 9QN
United Kingdom
M.W.Wheeler@sussex.ac.uk

1. Introduction

Consonant cluster reduction, illustrated with an English example in (1), is one of several types of process by which the number of output segments deviates from the number of input segments. A parallel process involving vowels is *apocope*, as in French *l'état* [leta] 'the state' /lə/ 'the' + /eta/ 'state' *[ləeta].

(1)	Base form	Contextual cluster reduction	
	hand [ˈhand]	*hands* [ˈhanz]	/hand+z/
		handful [ˈhaɱfʊl]	/hand+fʊl/

If we find more segments in the output than in the input, we typically speak of epenthesis in the broad sense (covering all insertions),[1] as in English *drawing* [ˈdɹɔːɹɪŋ] /ˈdɹɔː/ + /ɪŋ/, or Spanish *está* [esˈta] 'is.3SG.PR.IND' /ˈsta/. I use here the general terms 'input' and 'output', though, of course, deviation in the number of segments can be observed in the whole range of Optimality Theory correspondence relations such as Base−Reduplicant (2a), Base−Derivative (2b), or Word−Phrase (2c) illustrated again with examples of consonant-cluster reduction.

*I am very grateful to a *CJL* reader for many suggestions which have helped to improve the text.

[1] *Epenthesis* in the narrow sense is restricted to string-medial insertions; see Appendix.

(2)		Base form	Cluster reduction	
(a)	Prefixed reduplicant	Ancient Greek πράσσω [prá:ssɔ:] 'I make'	πέπραχα [pé-pra:kʰa] 'I have made'	*[pré-pra:kʰa]
(b)	Prefixed root	Latin *ex* [eks] 'out'	*eligo* [e:-ligo:] 'I pick out'	*[eks-ligo:]
(c)	Phrasal sandhi	*hand* [hand]	*right hand side* […han saɪd]	*[…hand saɪd]

Within Optimality Theory, it is Correspondence Theory which deals in general terms with deviations from faithfulness (McCarthy & Prince 1999, a revised and reduced version of McCarthy & Prince 1995; McCarthy 1995), and in Correspondence Theory several types of constraint have been formulated that penalize different varieties of unfaithfulness. In the case of processes involving deviation from faithfulness in the number of segments, phonologists have generally spoken of cluster reduction and apocope in terms of *deletion*, or violation of MAX, and of epenthesis in terms of *insertion*, or violation of DEP. It is the argument of this paper that exclusive reliance on MAX in dealing with cluster reduction works only if coalescence candidates are ignored, which, granted that GEN supplies such candidates, they should not be. For any grammar where, in some circumstances, coalescence candidates must win, it is necessary for the phonologist to show why, in a particular case, a deletion candidate is superior to an alternative coalescence candidate. What looks like 'deletion' cannot be assumed to be simply the consequence of some markedness constraint outranking MAX. Candidates violating MAX have to be shown to be better than alternatives that lack the MAX violation. Some examples of alternative candidates for cluster reduction in *hands* are presented in (3).

(3) Base form	Contextual cluster reduction		
	Inflected input	Deletion	Selected coalescence candidates
hand [hand]	*hands* /$\text{han}_1\text{d}_2\text{+z}_3$/	han_1z	$\text{han}_{1,2}\text{z}$, $\text{hanz}_{2,3}$ $\text{ha}\widehat{\text{nd}}_{1,2}\text{z}$, $\text{han}_1\widehat{\text{dz}}_{2,3}$, $\text{ha}\widehat{\text{ndz}}_{1,2,3}$

To put it another way, cluster reduction illustrates not simply the ranking of Markedness above MAX; it must involve some explicit ranking of Markedness, MAX and UNIFORMITY,

UNIFORMITY being the constraint that penalizes coalescence. This point appears to have been overlooked by phonologists who have treated cluster reduction in the light of Correspondence Theory, starting with Lamontagne and Rice (1995).[2] Cluster reduction in Catalan, the focus of section 4 of this paper, has been treated by Jiménez (1999), Dols (2000) and Pons (2004). All of these authors cite McCarthy & Prince (1995), and Jiménez in particular (225-240) has winning coalescence candidates in consonant cluster contexts, such as *pots comprar* [ˌpɔ͡ts.kom.ˈpraɾ] 'you can buy'. In her extensive survey of consonant cluster reduction and epenthesis, Côté (2001) too ignores the role of coalescence or breaking candidates (and of the constraints they violate):

> 'The markedness constraints against non-prevocalic consonants interact with faithfulness constraints to yield the attested patterns. Since I deal here only with epenthesis and deletion, I use the following two basic constraints…
>
> a. MAX Do not delete
>
> b. DEP Do not epenthesize.' (163)

The problem involved in ignoring coalescence candidates provided by GEN can be illustrated in Lamontagne & Rice's (1995)[3] account of some consonantal cluster reduction phenomena in Navajo prefixal inflection known as the 'D-effect'. The D-effect involves both 'deletion' (4a) and coalescence (4b) as repairs to potential NOCODA violations. Symbols such as [d], [g] in Navajo transcriptions denote voiceless unaspirated stops, while [t], [k] denote voiceless aspirated stops. Note that Lamontagne & Rice's NOCODA penalizes only internal codas, i.e. it is $*C]_\sigma C$.

(4)	Navajo	Cluster reduction	
a.	/d/ + stop-initial stem	/ʔi+ii+d+kááh/ → [ʔii.kááh] 'we make a sand painting'	deletion
b.	/d/ + fricative-initial stem	/na+ii+d+xaał/ → [nei.gaał] 'we look around'	coalescence

[2] McCarthy (1995: 50) does address the theoretical point, though in the context of discussion of umlaut (in Rotuman) rather than of cluster reduction.

[3] I am grateful to Keren Rice for supplying me with a copy of this paper. Lamontagne & Rice's account uses some preliminary formulations of correspondence constraints which I replace here with their now more familiar versions (after McCarthy & Prince 1999); the form of their argument is not affected by this modification.

In the structure illustrated in (4) codas are avoided (by NOCODA). Before a stem beginning with a stop the element /d/ is 'deleted' (4a); in the case where a stem begins with a fricative (4b), the input sequence of /d/ + C is realized as a 'coalesced' stop with the laryngeal stricture of /d/ and the place of articulation of the stem-initial consonant /x/, namely [g]. Lamontagne and Rice offer tableaux of the forms in (5) and (6) for the two processes respectively.

(5)

ʔi+ii+d_1+$k_2$ááh	NOCODA	MAX
a. ʔiid_1.$k_2$ááh	*!	
b. ☞ ʔii.$k_2$ááh		*

(6)

na+ii+d_1+$x_2$aał	NOCODA	MAX	UNIF
a. neid_1.$x_2$aał	*!		
b. nei.$x_2$aał		*!	
c. ☞ nei.$g_{1,2}$aał			*

On the basis of these tableaux Lamontagne and Rice conclude (1995: 218): 'to summarize, deletion involves a [MAX] violation while coalescence involves a violation of another constraint on correspondence, namely [UNIFORMITY]. In Navajo-type Athapaskan languages, the D-effect facts follow if [MAX] » [UNIFORMITY] (and both of these constraints are dominated by NOCODA).' Lamontagne and Rice add some discussion on why 'deletion' occurs before stops, and why coalescence with stem-initial fricatives takes the form it does, which mentions aspects of differential featural faithfulness and featural alignment. What Lamontagne & Rice do not observe is that with the constraint ranking NOCODA » MAX » UNIFORMITY, their intended winning candidate (5b) would in fact lose to a fusion candidate such as [ʔii.$k_{1,2}$ááh], or indeed *[ʔii.$g_{1,2}$ááh] which maintains the laryngeal stricture of its first correspondent stop segment just as the winner does in (6c). That is, once MAX dominates UNIFORMITY in the grammar, 'coalescence' candidates will always be more harmonic than deletion ones, *unless the coalescence candidates are themselves ruled out by some higher ranking constraint(s)*.

The structure of the remainder of the paper is as follows. In section 2, I review Correspondence Theory focusing especially on how correspondence constraints treat cluster reduction. In section 3 I show how Lamontagne and Rice's account of Navajo can and must be elaborated to express the desired result. In section 4 I investigate a sample of consonant cluster reduction in Catalan, exploring further the contributions of 'deletion' and coalescence, and their interaction with particular types of perceptual markedness and with morphological analogy. Section 5 introduces some broader consequences of the issues raised in the body of the paper.

2. Correspondence Theory reviewed

In this section I review Correspondence Theory highlighting issues of multiple correspondence. I also draw attention to some other interactions between the types of constraint that compose Correspondence Theory. In the discussion which follows I refer to 'input' and 'output' generally, whatever the specific basis of correspondence. In the notation convention of McCarthy & Prince, S_1 denotes input in this general sense, while S_2 denotes output.

The definitions of correspondence constraints (7)-(16) are those of McCarthy & Prince (1999: 293-296).

(7) MAX [MAXIMALITY]

Every element of S_1 has a correspondent in S_2.

Domain $(\Re) = S_1$.

MAX penalizes segment deletion in any position. 'Element' in the constraint definition conventionally means 'segment', though moras have also been protected in this way. (In principle, if MAX is applicable to moras, one should expect it to be applicable to other elements of the prosodic hierarchy, syllable, foot, and so on.) The loss of features carried by a deleted segment is not specifically penalized by MAX. For this reason some phonologists make use of a MAX(Feature) constraint type, for individual features, so that the absence of a specific input feature in any correspondent in the output is penalized (for example, Lombardi 2001: 21, expanding suggestions made in McCarthy & Prince 1995: 71, and discussed slightly more fully in McCarthy 1995: 50-52).

(8) DEP [DEPENDENCE]

Every element of S_2 has a correspondent in S_1.

Range ($\Re$) = S_2.

DEP penalizes insertion in any position, conventionally of segments, but in principle, by analogy with the interpretation of MAX, also of prosodic elements such as mora. DEP(Feature) seems not to be used, doubtless because the effect is more perspicuously achieved by markedness constraints, in Input-Output correspondence, at least. DEP(Feature) constraints are likely to have a significant role in Output-Output correspondence.

MAX and DEP are the most general constraints of a family whose other members, namely CONTIGUITY, ANCHOR, and ADJACENCY (see below), penalize deletion or insertion in specific segmental string patterns. Of these, ANCHOR and ADJACENCY have effects beyond penalizing deletion and insertion, whereas CONTIGUITY is simply a positionally restricted version of MAX/DEP. If there are MAX and DEP constraints for phonetic features, it follows that CONTIGUITY(Feature), ANCHOR(Feature), and ADJACENCY(Feature) will also be appropriate.

(9) IDENT(F[eature])

Correspondent segments have identical values for the feature F.

If $x\Re y$ and x is [γF], then y is [γF].

It is IDENT(F) that requires feature matching in correspondent segments; however, IDENT(F) is not violated in segments that lack a correspondent. So features of deleted segments are lost without penalty by IDENT(F), and insertion can introduce features not present in the input without violation of IDENT(F). In cases of coalescence or breaking (= splitting), IDENT(F) is typically violated, for some feature or features, except where coalescence and breaking consist of degemination and gemination respectively. McCarthy & Prince (1995: 71) initiating a discussion of MAX(F) and DEP(F), ponder whether IDENT(F) may actually be replaceable by constraints of the MAX and DEP types.

(10) I-CONTIGUITY (‘No skipping’)

The portion of S_1 standing in correspondence forms a contiguous string.

Domain ($\Re$) is a single contiguous string in S_1.

I-CONTIGUITY penalizes syncope. In cases of syncope (see Appendix) a segment internal to S_1 lacks a correspondent in the output. Thus in $a_1b_2c_3 \rightarrow a'_1c'_3$ the portion of S_1 that stands in correspondence consists of a_1 and c_3, which are not contiguous. Deletion at an edge is not penalized; thus in apocope, for example $a_1b_2c_3 \rightarrow a'_1b'_2$, the portion of S_1 that stands in correspondence is the contiguous a_1b_2. Notice that I-CONTIGUITY does not require that what is contiguous in the input *be contiguous* in the output: I-CONTIGUITY does not penalize (internal) epenthesis —that is the role of O-CONTIGUITY— nor does it penalize coalescence. Thus the realization $a_1b_2c_3 \rightarrow a'_1c'_{2,3}$, where $c'_{2,3}$ in the output corresponds to the sequence of segments b_2c_3 in the input, does not involve a CONTIGUITY violation, even though a'_1 is contiguous with c'_3 in the output, while their correspondents in the input are separated by b_2.

(11) O-CONTIGUITY (‘No intrusion’)
The portion of S_2 standing in correspondence forms a contiguous string.
Range ($\Re$) is a single contiguous string in S_2.

O-CONTIGUITY penalizes epenthesis in the strict sense, that is, non-edge insertion of segments. Thus abc →a′xb′c′ incurs an O-CONTIGUITY violation, while abc → a′b′c′x does not. Like I-CONTIGUITY, O-CONTIGUITY does not penalize coalescence or breaking.

The constraint sometimes simply named CONTIGUITY is an abbreviation for the constraint conjunction I-CONTIGUITY & O-CONTIGUITY, or refers to either or both of I-CONTIGUITY and O-CONTIGUITY, as may be relevant. CONTIGUITY does not inherently penalize metathesis provided that the corresponding portions of S_1 and S_2 form contiguous strings, as is the case in abc → b′a′c′. However, it is not entirely clear how one is intended to identify the ‘portions of S_1/S_2 standing in correspondence’. The portions standing in correspondence are usually taken to be whole morphemes (Kager 1999: 251), but not morpheme strings. Strictly, then, the CONTIGUITY constraints, like ADJACENCY (see below) need to have specified a morphological or prosodic domain. Thus, a sequence of two morphemes such as English *hands* /$h_1a_2n_3d_4$+z_5/, realized [$h_1a_2n_3z_5$], is not interpreted as involving an I-CONTIGUITY violation, but rather (beyond the general MAX violation) as involving a violation of RIGHT-ANCHOR at the edge of a Stem morpheme.

(12) [RIGHT, LEFT] ANCHOR (S_1, S_2)

Any element at the designated periphery of S_1 has a correspondent at the designated periphery of S_2.

Let *Edge*(X, {L, R}) = the element standing at the *Edge* = L, R of X.

RIGHT-ANCHOR. If x = Edge(S_1, R) and y = Edge(S_2, R) then $x\Re y$.

LEFT-ANCHOR. Likewise, *mutatis mutandis*.

Conceptually, ANCHOR constraints reflect the stronger faithfulness requirements of constituent edges; in this respect, they are part of a Positional Faithfulness approach (Beckman 1998). In the definition of ANCHOR, X stands for a prosodic category, like Foot, Syllable, or Phonological Word, or for a morphological category, such as Root, Stem, or Affix. McCarthy & Prince (1999: 295) intend that ANCHOR constraints should subsume Generalized Alignment (McCarthy & Prince 1993). The same point is made by McCarthy (2003: 89) who introduces a D-ANCHOR[4] constraint specifically regulating the concatenation of morphemes that I do not consider further here.

(13) LINEARITY ('No metathesis')

S_1 is consistent with the precedence structure of S_2 and vice versa.

Let $x, y \in S_1$ and $x', y' \in S_2$.

If $x\Re x'$ and $y\Re y'$ then

$x < y$ iff $\neg (y' < x')$

The LINEARITY constraint penalizes all metathesis of corresponding segments, though not coalescence or breaking. That is to say, for example, if a precedes b in the input, it does not matter if a′ coalesces with b′ in the output (so a′ ceases to precede b′); it is only when precedence is reversed so b′ precedes a′ in the output that a penalty is incurred.

None of the constraints so far listed (7)-(13) penalizes multiple correspondence, that is, where one segment in the output corresponds to more than one segment in the input

---

[4] The definition is as follows (McCarthy 2003: 90):

D-ANCHOR (C_I, C_O, E)

If x = Edge(C_I, E) and y = Edge(C_O, $\bar{E}$), then $x\Re x'$ and x′ is immediately adjacent to y.

'Any element at the designated edge of C_I has a correspondent that is adjacent to an element at the opposite edge of C_O.'

(coalescence), or vice versa (breaking). UNIFORMITY and INTEGRITY are the constraints that address such cases.

(14) UNIFORMITY (‘No coalescence’)

No element of S_2 has multiple correspondents in S_1.

For $x, y \in S_1$ and $z \in S_2$, if $x\Re z$ and $y\Re z$ then $x = y$.

UNIFORMITY penalizes segmental coalescence, also referred to as fusion (for example, in Pater 1999). Except in the case where coalescence consists of degemination (e.g. [k_1k_2] → [$k_{1,2}$]), coalescence will entail some violation of IDENT(F), since different adjacent segments must differ in some feature. However, the coalescence of two consonants as an affricate, with a segment-internal ‘contour’ [[−cont][+cont]], such as [t_1s_2] → [$\widehat{ts}_{1,2}$], need not incur an IDENT(F) violation. The same consideration applies to a vowel bearing a contour tone, such as [[H][L]] for a falling tone, or to a short diphthong such as [$\widehat{ea}$] [[−low][+low]]. Exactly how Correspondence Theory deals with contour segments remains to be worked out. What, for example, is the constraint that would penalize unfaithful ordering of contour feature values? By what constraint are both [$\widehat{st}'$] and [$\widehat{ts}'$] not equally good coalesced correspondents of input [ts] (or, indeed, of input [st])? It may be that a constraint LINEARITY(F) is required, to penalize reversal in the order of features separately from the segments they appear in.[5] Is UNIFORMITY evaluated categorically or gradiently? In practice it is evaluated categorically — and this is what follows from the literal interpretation of the definition; so coalescence of three segments into one ($a_1b_2c_3 \rightarrow x'_{1,2,3}$) is not more penalized than coalescence of two segments ($a_1b_2c_3 \rightarrow x'_{1,2}c_3$).

(15) INTEGRITY (‘No breaking’)

No element of S_1 has multiple correspondents in S_2.

For $x \in S_1$ and $w, z \in S_2$, if $x\Re w$ and $x\Re z$, then $w = z$.

---

[5] An ‘anti-affricate’ like [$\widehat{st}$] might be excluded by a high-ranked markedness constraint *[[+cont][−cont]]. But markedness could not select the correct ordering of contour features of vowel quality, or of tone.

INTEGRITY is the matching constraint to UNIFORMITY, penalizing what McCarthy & Prince (1999) label 'breaking' (a term applied to the diphthongization of vowels in the history of Old English, for example), though 'splitting' might be a conceptually more neutral term —or indeed 'scission', if we seek to match the Greco-Latin derivation of the remainder of the body of terms for both correspondence 'deviations' (see Appendix) and correspondence constraints.

The addition of another pair of correspondence constraints with the general label ADJACENCY is proposed by Carpenter (2002). ADJACENCY constraints are similar to CONTIGUITY constraints in that they penalize syncope or epenthesis. However, ADJACENCY also blocks coalescence. Within a specified domain, such as a syllable, ADJACENCY permits some cases of metathesis ($a_1b_2 \rightarrow b'_2a'_1$), including metathesis around a pivot ($a_1b_2c_3 \rightarrow c'_3b'_2a'_1$).

(16) I-ADJACENCY$_{(\text{DOMAIN})}$ (Carpenter 2002)

If x is adjacent to y in the input, and x and y $\in$ Domain, then x′ must be adjacent to y′ in the output.

Let x, y $\in S_1$ and x′, y′ $\in S_2$.

If $x\Re x'$ and $y\Re y'$, and x is adjacent to y then x′ is adjacent to y′.

(17) O-ADJACENCY$_{(\text{DOMAIN})}$ (Carpenter 2002)

If x is adjacent to y in the output, and x and y $\in$ Domain, then x′ must be adjacent to y′ in the input.

Let x, y $\in S_2$ and x′, y′ $\in S_1$.

If $x\Re x'$ and $y\Re y'$, and x is adjacent to y then x′ is adjacent to y′.

In the Appendix I establish a taxonomy of segmental deviations from utterly faithful one-to-one correspondence, using largely the traditional terminology for phonetic 'figures of speech'. This is set out in a table showing which deviations are penalized by which constraints.

3. Trying again with deletion and coalescence in Navajo

Lamontagne and Rice's (1995) account of the Navajo D-effect requires a coalescence candidate to win in examples like /na+ii+d_1+$x_2$aał/ $\rightarrow$ [nei.$g_{1,2}$aał] 'we look around', while, for stop-initial roots the winning candidate looks like a case of deletion: /ʔi+ii+d_1+$k_2$ááh/ → [ʔii.$k_2$ááh] ‘we make a sand painting’. But the constraint ranking they offer, NoCoda » Max » Uniformity, actually entails that in the latter case the deletion candidate falls to some coalescence candidate, such as [ʔii.$k_{1,2}$ááh]. Now, if the only coalescence candidate conceivable were precisely [ʔii.$k_{1,2}$ááh], which is identical in pronunciation to Lamontagne and Rice’s preferred winner, the whole matter would be of little consequence. But as soon as it is accepted that *some* coalescence candidate can win, it is up to the analyst to demonstrate why it is this coalescence candidate that wins rather than some other, such as *[ʔii.$g_{1,2}$ááh]. Following up Lamontagne and Rice’s suggestions about featural alignment for the coalescence case, some appropriate feature Positional Faithfulness constraints can be proposed. The first is IdentPA/RootInitial: ‘Correspondent consonant segments that are root-initial have the same Place of Articulation features’. In tableau (18) IdentPA/RootInitial rules out coalescence candidates for /ʔi+ii+d+kááh/ which lack a root-initial velar, such as (18e). The second Positional Faithfulness constraint to be proposed is IdentAsp/Stop/RootInitial, informally: ‘Correspondent obstruent stop segments that are root-initial have the same aspiration feature’. (‘Aspiration’ here is a cover term standing in for whatever feature or features expresses the phonological distinction appropriate in Navajo.) These two constraints ensure that candidate (18c) beats plausible alternatives such as (18d) that also retain features of the input segments involved, /d/ and /k/. Since the winning candidate displays no violation of Max, unlike in (5), there is no longer evidence for ranking of Max with respect to NoCoda.

(18)

ʔi+ii+d$_1$+k$_2$ááh	NoCoda	Max	Uniformity	Id[−cont]	IdPA/RootInitial	IdAsp/Stop/RootInitial	IdAsp/Stop
a. ʔiid$_1$.k$_2$ááh	*!						
b. ʔii.k$_2$ááh		*!					
c. ☞ ʔii.k$_{1,2}$ááh			*				*
d. ʔii.g$_{1,2}$ááh			*			*!	*
e. ʔii.t$_{1,2}$ááh			*		*!		*

The role of the other two new constraints in (18), IDENT[−cont] and IDENTAsp/Stop becomes clearer when we consider the coalescence winner in tableau (19) for /na+ii+d$_1$+x$_2$aaɬ/. In (19) IDENT[−cont] prefers a stop output (19f, g, j, k) when a stop and a continuant coalesce.[6] Finally IDENTAsp/Stop requires that any obstruent stop which has an obstruent stop correspondent have the same aspiration feature. Together with IDENTPA/RootInitial, these constraints ensure that the coalescence output of a stop followed by a root-initial fricative matches the stop and aspiration features of the former, and the place features of the latter. I assume, as Lamontagne and Rice do, that high-ranking markedness constraints rule out complex segments with more than one place feature. We also need to rule out an output with a voiced velar affricate *[nei.$\widehat{\text{gɣ}}_{1,2}$aaɬ] without ruling out the affricates Lamontagne and Rice tell us that Navajo does have, namely: [$\widehat{\text{ts}}$, $\widehat{\text{dz}}$, $\widehat{\text{ts}}$’]. Conceivably this effect follows from markedness constraints against non-coronal affricates that outrank markedness constraints against all affricates. I pursue this question no further here.

[6] Without further knowledge of Navajo, I do not pursue here why this might be. Possibly, by the Sonority Sequencing principle, and the Syllable Contact law, stops are preferred to fricatives in onsets, other things being equal.

(19)

na+ii+d₁+x₂aaɬ		NoCoda	Max	Uniformity	Id[−cont]	IdPA/RootInitial	IdAsp/Stop
a.	neid$_1$.x$_2$aaɬ	*!					
b.	nei.x$_2$aaɬ		*!				
c.	nei.g$_2$aaɬ		*!				
d.	nei.x$_{1,2}$aaɬ			*	*!		
e.	nei.ɣ$_{1,2}$aaɬ			*	*!		
f.	☞ nei.g$_{1,2}$aaɬ			*			
g.	nei.k$_{1,2}$aaɬ			*			*!
h.	nei.θ$_{1,2}$aaɬ			*	*!	*	
i.	nei.ð$_{1,2}$aaɬ			*	*!	*	
j.	nei.d$_{1,2}$aaɬ			*		*!	
k.	nei.t$_{1,2}$aaɬ			*		*!	*

What if, for other reasons, it were essential that the true 'deletion' candidate (18b), the MAX-violating one, should win for a case like /ʔi+ii+d+kááh/ → [ʔii.kááh] 'we make a sand painting' in Navajo? First, of course, to ensure this outcome we need the ranking UNIFORMITY » MAX. What would the remainder of the constraint ranking look like, so that for /na+ii+d+xaaɬ/ → [nei.gaaɬ] 'we look around' either the coalescence candidate [nei.g$_{1,2}$aaɬ] won, as before, or conceivably one of the deletion candidates, either [nei.g$_1$aaɬ] or [nei.g$_2$aaɬ], all three being pronounced the same? Now, when coalescence is disfavoured, some MAX(Feature) constraint(s), partly mirroring some IDENT(Feature) constraints in (18)-(19), must outrank UNIFORMITY; specifically, here, MAXAsp/Stop which, in the case of an input obstruent stop, penalizes an output lacking a correspondent aspiration feature on a corresponding stop. In this version where true deletion is favoured it is no longer possible to rely on IDENT(Feature) constraints which are not violated when the segment that manifests the feature has no correspondent. The positional MAX(Feature) constraint

L-ANCHORPA/Root: 'An input segment at the left edge of a root must have an output correspondent with the same Place of Articulation features' takes on the role that IDENTPA/RootInitial took in (18)-(19). The role of these constraints is illustrated in tableau (20); acceptable winners are any of (20e, f, g). I leave in the tableau the constraint IDENTPA/RootInitial, and include also IDENTPA (inherently ranked below it, by Panini's principle) to show that, in the absence of the constraint L-ANCHORPA/Root when UNIFORMITY outranks MAX, the winner would be incorrectly (20n) *[nei.$d_1$aaɬ], which has only a MAX(Segment) violation, thereby beating the acceptable (20e) [nei.$g_1$aaɬ], which violates both MAX(Segment) and IDENTPA. In (20) by MAXAsp/Stop candidates are eliminated that do not have a correspondent of /d_1/ that matches its [–cont, –aspirated] features. L-ANCHORPA/Root rules out candidates without a velar correspondent to the root-initial input.

(20)

na+ii+d_1+$x_2$aał		NoCoda	L-AnchorPA/Root	MaxAsp/Stop	Uniformity	Max	IdPA/RootInitial	IdAsp/Stop	IdPA
a.	neid_1.$x_2$aał	*!							
b.	nei.$x_1$aał		*!	*		*			*
c.	nei.$x_2$aał			*!		*			
d.	nei.$x_{1,2}$aał			*!	*				*
e.	nei.$g_1$aał		*!			*			*
f.	nei.$g_2$aał			*!		*			
g. ☞	nei.$g_{1,2}$aał				*				*
h.	nei.$ɣ_1$aał		*!	*		*			*
i.	nei.$ɣ_2$aał			*!		*			
j.	nei.$ɣ_{1,2}$aał			*!	*				*
k.	nei.$k_1$aał		*!	*		*		*	*
l.	nei.$k_2$aał			*!		*			
m.	nei.$k_{1,2}$aał			*!	*			*	*
n.	nei.$d_1$aał		*!			*			
o.	nei.$d_2$aał		*!	*		*	*		*
p.	nei.$d_{1,2}$aał		*!		*		*		*
q.	nei.$t_1$aał		*!	*		*		*	
r.	nei.$t_2$aał		*!	*		*	*		*
s.	nei.$t_{1,2}$aał		*!	*	*		*	*	*

In (21) I return to /ʔi+ii+d+kááh/ where the input has two stops that differ in aspiration. MaxAsp/Stop penalizes all the coalescence and deletion candidates illustrated. But (21e) has two violations: /d_1/ has no correspondent, and aspirated /k_2/ is realized unaspirated. With these two violations it loses to (21b), the 'true deletion' candidate.

(21)

ʔi+ii+d_1+$k_2$ááh		NoCoda	L-AnchorPA/Root	MaxAsp/Stop	Uniformity	Max	IdAsp/Stop
a.	ʔiid_1.$k_2$ááh	*!					
b. ☞	ʔii.$k_2$ááh			*		*	
c.	ʔii.$k_{1,2}$ááh			*	*!		*
d.	ʔii.$g_{1,2}$ááh			*	*!		*
e.	ʔii.$g_2$ááh			**!		*	*
f.	ʔii.$t_{1,2}$ááh		*!	*	*		*

It seems, then, that when we acknowledge that Gen freely supplies coalescence, the constraint ranking Uniformity » Max(Segment) will require the granting of full rights to constraints of the Max(Feature) family.[7]

4. Cluster reduction in Catalan: a sample case

Consonant cluster reduction in Catalan displays some important similarities with the Navajo example reviewed in the previous section, while introducing some additional complexities. These include the greater susceptibility of certain homorganic clusters to reduction than of heterorganic clusters, sandhi variation in reduction effects, and morphological or 'paradigm uniformity' effects. In the account which follows I adopt a conservative position with regard to Max(Feature) constraints mentioned at the end of the previous section. With Max(Segment) ranking above Uniformity (see below (25)), Max(Feature) constraints are not demonstrated to be active. The fact that Gen obliges us to account for coalescence candidates does not in itself require Max(Feature) constraints.

[7] McCarthy & Prince's original suggestion (1995: 71) about Max(Feature) arises precisely from the situation where 'outright deletion masquerades as coalescence'.

Consider the forms in (22) from the variety of Catalan spoken in Ibiza (data largely from Pons 2004: 353-422). Forms in **bold** display apparent deletion; forms in shaded cells display apparent coalescence. Forms in the remaining cells are faithful (apart from coda voicing neutralization which is not relevant to cluster reduction).

(22) Ibiza cluster reduction

	Stem	Singular			Plural		
		Citation	__#V	__#C	+z	+z __#C	+z __#V
a. *pont* 'bridge'	/pɔnt/	**ˈpɔn**	**ˈpɔ.n**	**ˈpɔn**	**ˈpɔns**	**ˈpɔns**	**ˈpɔn.z**
b. *molt* 'much, many'	/molt/	**ˈmol**	**ˈmo.l**	**ˈmol**	**ˈmols**	**ˈmols**	**ˈmol.z**
c. *porc* 'pig'	/pɔɾk/	ˈpɔɾk	ˈpɔɾ.k	**ˈpɔɾ**	ˈpɔɾks	**ˈpɔɾs**	**ˈpɔɾ.z**
d. *verd* 'green'	/vəɾd/	ˈvəɾt	ˈvəɾ.t	**ˈvəɾ**	ˈvəɾt͡s	**ˈvəɾs**	**ˈvəɾ.z**
e. *tot* 'all'	/tot/	ˈtot	ˈto.t	ˈtot	ˈtot͡s	ˈtot͡s	ˈtod͡.d͡z
f. *triomf* 'triumph'	/tɾiomf/	tɾiˈoɱf	tɾiˈoɱ.f	tɾiˈoɱf	tɾiˈoɱfs	tɾiˈoɱfs	tɾiˈoɱv.z

In examples such as those in (22) the stem-final clusters always appear non-reduced before vowel-initial suffixes. Thus we find *pontet* [pun.ˈtət] 'bridge.DIM'; *molta* [ˈmol.tə] 'much.F'. In these pre-vocalic contexts, of course, the cluster is divided between syllables. In (22a) and (22b) where the stem-final cluster is homorganic and both members are [–continuant], the cluster is, in fact, reduced in all cases except when a vowel-initial morpheme follows *in the same word*. In the (22c) type the members of the cluster ([ɾk]) differ in both place and continuancy. Reduction takes place before consonant-initial words, and also before plural /+z/ before a vowel-initial word, though not before /+z/ in the plural utterance-final (citation) form. Type (22d) has a cluster ([ɾd]) whose members differ in continuancy but not in place; the outcome is broadly similar to the (22c) example, but here there is the opportunity to coalesce an obstruent stop and a homorganic fricative (/+z/) into an affricate. Coalescence is preferred to reduction, but only in utterance-final position, not elsewhere. Example (22e) shows that coalescence of /t/ or /d/ with /s/ or /z/ is a general pattern which is not restricted to words with stem-final clusters or to utterance-final forms. Finally, (22f) shows a cluster that remains faithful to the input across environments; the members differ in continuancy but not in place. The overall pattern of cluster reduction in Ibiza is similar to the pattern found in the Catalan of Catalonia, except that in Catalonia in type (22d) an affricate is not found, so the plural of *vert* 'green' is [bɛrs] ([bɛr.z] before a vowel-initial word), and, in more 'advanced' varieties, *vert* is realized with cluster reduction [bɛr] in the singular also. I give no further consideration here to the realization of clusters before vowel-initial words; see Wheeler (in press: chapter 7) for an account of the realization of clusters in these contexts.

Cluster reduction in most contexts in words of the (22a) and (22b) types is favoured by the fact that the clusters involved here are 'partial geminates': place of articulation is shared, together with an important aspect of manner of articulation, namely, non-continuancy. Such clusters, I claim, are perceptually marked (Wheeler in press §7.2; Côté 2001: chapter 4). The best perceptual cues for most consonants come in transitions to a following vowel or vowel-like sonorant (approximant). In the absence of a following vowel, a consonant which has few features distinguishing it in place or manner from a preceding consonant is perceptually indistinct, and is less suitable than a more contrastive consonant for maintaining lexical contrasts. In Côté's words, 'the more similar a consonant is to a neighbouring segment, the more it needs to be adjacent to a vowel to comply with the Principle of Perceptual salience' (Côté 2001: 198). The OT constraints expressing this difference in markedness between cluster types may be interpreted, Côté suggests, either as (positional) markedness constraints or as (positional) faithfulness constraints. I take the former option here. The two constraints (23a) and (23b) are my own formulations, in the spirit of Côté (2001: 169-70, 175, 185, 199-200).

(23) a. C*C¬ContrPA: A consonant that lacks a contrast in place of articulation with a preceding consonant incurs a violation mark, unless a vowel or approximant follows.

b. C*C¬ContrCont: A consonant that lacks a contrast in continuancy with a preceding consonant incurs a violation mark, unless a vowel or approximant follows.[8]

Observe that, as perceptual markedness constraints, those in (23) penalize clusters such as [nt], [mb], but not clusters such as [rk] or [mz]. Heterorganic clusters like [mt], [nb], violate

[8] The constraints (23a-b) elaborate the *GEMINATECODA constraint proposed in Wheeler (in press; §7.1). In line with Côté's approach, they are formulated in accord with 'licensing by cue', hence the formulation 'unless a vowel or approximant follows' in place of an appeal to syllable position ('licensing by prosody').

(23b) C*C¬ContrCont only; that is, they are perceptually less marked than [nt], [mb]. Nonetheless, heterorganic clusters are *articulatorily* more marked than homorganic clusters. Articulatory markedness scales are different from, and often, naturally, the opposite of perceptual markedness scales. Greater contrastiveness, whether paradigmatic or syntagmatic, requires more articulatory effort than (paradigmatic) merger or (syntagmatic) assimilation.

Other constraints relevant to Catalan consonant clusters are those penalizing complex codas, such as $*CC]_{\sigma}$, or more specifically complex pre-consonantal codas such as $*CC]_{\sigma}C$. Such clusters display both articulatory and perceptual markedness. In a language like Catalan where coda affricates are possible one must infer that constraints are active that penalize coda complexity not simply in numbers of consonantal segments, but rather in numbers of different manners of articulation. Hence I propose a THREE-MANNER PRE-CONSONANT CODA constraint (cf. Wheeler in press §7.1)

(24) *THREE-MANNER PRE-CONSONANT CODA ($*3MAN]_{\sigma}C$): There is no more than one point where change of Manner of Articulation occurs within a pre-consonant coda (where Manner means Rhotic, Nasal, Sibilant, Lateral, [±continuant] or [±sonorant]).

Tableau (25) illustrates the general pattern of affricate coalescence: some cluster constraint, such as here C*C¬ContrPA, together with MAX, outranks UNIFORMITY. Some faithfulness constraints concerning stridency and manner of articulation are also active. *Tots* [to͡ts] 'all.MPL' with an affricate (25f) is better than alternatives with true deletion (25b, d) or non-affricate coalescence (25c, e). (Final coda voicing neutralization is undominated in Catalan.)

(25) MAX, IDENTManner, C*C¬ContrPA » UNIFORMITY

tots 'all.MPL' tot_1+z_2	IDENTStrid	MAX	IDENTManner	C*C¬ContrPA	UNIFORMITY
a. tot_1s_2				*!	
b. tot_1		*!			
c. $tot_{1,2}$	*!		*		*
d. tos_1		*!			
e. tos_{12}			*!		*
f. ☞ $\widehat{ts}$: to$\widehat{ts}_{1,2}$					*

In the following tableaux I select examples that demonstrate which constraints are active in Catalan cluster reduction, and their ranking relative to one another. Tableau (26a) takes the citation form of *verd* 'green' to demonstrate that faithfulness to manner of articulation (IDENTManner), in fact, outranks C*C¬ContrPA; the winner (26a.iv) has a homorganic coda cluster. By contrast, in (26b), in pre-consonantal position within a phrase, the complex pre-consonant coda constraint *CC]$_\sigma$C comes into play, preferring a reduced candidate to a faithful one. By IDENTRhotic the candidate (26b.i) that preserves the Rhotic wins over the alternative that preserves the stop. And the implied ranking IDENTRhotic » IDENTObstruent along with other constraints that favour sonorant codas, reflects the Syllable Contact Law — also an aspect of perceptual salience— by which the 'best' pre-consonantal codas are sonorants, and the best onsets are obstruent stops. More precisely, there is an inherent ranking deriving from syllable-structure markedness IDENTCodaRhotic » IDENTRhotic, IDENTCodaObstruent. As mentioned previously, in the 'advanced' variety of Catalan of Catalonia, for *verd* 'green', reduced [bɛr] is preferred to faithful [bɛrt]. This outcome follows from C*C¬ContrPA being promoted above IDENTManner.

(26) MAX, IDENTRhotic, *CC]$_{\sigma}$C » IDENTManner » C*C¬ContrPA » UNIFORMITY

		MAX	IDENTRhotic	*CC]$_{\sigma}$C	IDENTManner	C*C¬ContrPA	UNIFORMITY
a.	*verd* 'green' vəɾ$_{1}$t$_{2}$						
	i. vəɾ$_{1}$	*!					
	ii. vəɾ$_{1,2}$				*!		*
	iii. vət$_{1,2}$		*!		*		*
	iv. ☞ vəɾ$_{1}$t$_{2}$					*	
b.	vəɾ$_{1}$t$_{2}$#C						
	i. ☞ vəɾ$_{1,2}$#C				*		*
	ii. vət$_{1,2}$#C		*!		*		*
	iii. vəɾ$_{1}$t$_{2}$#C			*!		*	

Faithful pre-consonantal *triomf* [tɾioɱf] 'triumph' (22f) also shows some faithfulness constraints outranking the complex pre-consonantal coda constraint *CC]$_{\sigma}$C as displayed in (27).

(27) IDENTStrid, IDENTNasal » *CC$_{\sigma}$C

triomf 'triumph' tɾiom$_{1}$f$_{2}$#C	IDENTStrid	IDENTNas	*CC]$_{\sigma}$C	UNIFORMITY
a. ☞ tɾiˈoɱ$_{1}$f$_{2}$#C			*	
b. tɾiˈoɱ$_{1,2}$#C	*!			*
c. tɾiˈof$_{1,2}$#C		*!		*

Now I can show the constraint hierarchy accounting for the pattern of citation-form cluster reduction in *pont* [pɔn] 'bridge' (22a) and *molt* [mol] 'much' (22b). Tableau (28) for *molt* also shows the preservative effect of IDENTLateral, which in concert with some previously mentioned IDENT constraints, favours sonorant codas over obstruent ones.

(28) IDENTLateral, C*C¬ContrCont » IDENTManner

molt 'much' mol_1t_2	IDENTLat	C*C¬ContrCont	IDENTManner	UNIFORMITY
a. mol_1t_2		*!		
b. ☞ $mol_{1,2}$			*	*
c. $mot_{1,2}$	*!		*	*

Morphological analogy plays some role in the realization of Catalan consonant clusters, though morphological analogy is often overridden by phonological markedness. I simplify the issue here by mentioning just a PARADIGM UNIFORMITY constraint for the nominal number paradigm PUsg/pl, which abbreviates several constraints like O-ODEPC, O-OMAXC, O-OIDENTManner, or their Optimal Paradigms versions (McCarthy 2005, Pons 2004). Tableau (29) considers the cases of *verds* [vər͡ts] 'green.MPL', *molts* [mols] 'many.MPL' and *triomfs* [tɾioɱfs] 'triumphs', whose final clusters display affrication, reduction and faithfulness respectively. In (29a.ii) [vər͡ts] wins as the plural of [vərt]. However, in (29b) the parallel *[mol͡ts], which beats [mols] on C*C¬ContrCont (assuming [l] is [−cont] only next to a homorganic stop; see Wheeler in press chapter 10) and on IDENT Manner, loses by PARADIGM UNIFORMITY: the singular is realized [mol] so it is better to construct the plural on this form. The final complex cluster in [tɾioɱfs] violates several cluster-markedness constraints, but it is better to maintain the form of the stem [tɾioɱf], and also the sibilance of the suffix /+z/, than to simplify the cluster.[9]

[9] In the more conservative variety in Catalonia which for *vert* 'green' has [bɛrt] in the singular but [bɛrs] in the plural, the complex coda constraint *THREE-MANNER CODA (*CCC]$_\sigma$: 'There is no more than one point where change of Manner of Articulation occurs within a coda') outranks PUsg/pl.

(29) IDENTSib, PUsg/pl » C*C¬ContrCont » IDENT Manner » C*C¬ContrPA » UNIFORMITY

		IDENTSib	PUsg/pl	C*C¬ContrCont	IDENTManner	C*C¬ContrPA	UNIFORMITY
a.	vəɾ$_1$t$_2$+z$_3$ sg. [vərt]						
	i. vəɾ$_1$t$_2$s$_3$					**!	
	ii. vəɾ$_{1,2}$s		*!	*	*	*	*
	iii. ☞ vəɾ$_1$t͡s$_{2,3}$					*	*
b.	mol$_1$t$_2$+z sg. [mol]						
	i. mol$_1$t$_2$s$_3$		*!	*		**	
	ii. ☞ mol$_{1,2}$s			*	*	*	*
	iii. mol$_1$t͡s$_{2,3}$		*!			*	*
c.	tɾiom$_1$f$_2$+z$_3$ sg. [tɾioɱf]						
	i. ☞ tɾioɱ$_1$f$_2$s$_3$			*		*	
	ii. tɾiom$_{1,2}$s		*!		*		*
	iii. tɾiof$_{1,2}$s		*!	*	*		*
	iv. tɾioms$_{2,3}$		*!				*
	v. tɾioɱf$_{2,3}$	*!				*	*

Yet, while we observe some complex clusters can be retained in Ibiza Catalan in utterance-final forms, reduction is more widespread in forms uttered before a following consonant. In this context (30), illustrating pre-consonantal *porcs* 'pigs', we see that the *THREE-MANNER PRE-CONSONANT CODA (*3MAN]$_\sigma$C) constraint outranks PARADIGM UNIFORMITY. The faithful candidate (30a) which also contains the singular [pɔrk], loses on *THREE-MANNER PRE-CONSONANT CODA (*3MAN]$_\sigma$C); candidate (30c) which also recapitulates the singular form, at the cost of losing the plural marker, is excluded by high ranking IDENTSibilant.

(30) IDENTSib, IDENTRhotic, *3MAN]$_\sigma$C » PUsg/pl » *CC]$_\sigma$C

pɔɾ$_1$k$_2$+z$_3$#C sg [pɔɾk]	IDENTSib	IDENTRhotic	*3MAN]$_\sigma$C	PUsg/pl	*CC]$_\sigma$C
a. pɔɾks#C			*!		*
b. pɔk$_{1,2}$s#C		*!		*	*
c. pɔɾk$_{2,3}$#C	*!				*
d. ☞ pɔɾ$_{1,2}$s#C				*	*
e. pɔɾ$_{1,2,3}$#C	*!			*	

The overall ranking of the constraints considered in this section is as follows (31):

(31) MAX, IDENTNasal, IDENTLateral, IDENTRhotic, IDENTStrident, IDENTSibilant,
*THREE-MANNER PRE-CONSONANT CODA (*3MAN]$_\sigma$C)

»

PUsg/pl

»

C*C¬ContrCont, *CC]$_\sigma$C

»

IDENTManner

»

C*C¬ContrPA

»

UNIFORMITY

The faithfulness constraints at the top of the ranking protect coda sonorants, stridents ([s, f]) and sibilants [s, ʃ] from cluster reduction effects. High-ranking MAX means true deletion is not acceptable as a repair to coda complexity of any type. PARADIGM UNIFORMITY requiring singular and plural stems to match in form ranks high, but below at least one coda cluster constraint *THREE-MANNER PRE-CONSONANT CODA (*3MAN]$_\sigma$C). Other cluster constraints stand above UNIFORMITY, though IDENTManner is interleaved between them to protect a cluster like [ɾt] that lacks a place contrast. An important conclusion from these observations is that, when UNIFORMITY is ranked relatively low (and in any case below MAX), cluster reduction that looks like deletion is in fact coalescence. It is not necessarily the case, however, that in a language like Catalan reduced clusters always display coalescence. In the Majorcan variety I examine in more detail in Wheeler (in press), *gust* 'taste' [gust] is realized [gus$_1$] (true deletion) in pre-consonantal position, while its plural *gusts* [gut͡s$_{1,2,3}$] is realized [gut$_{1,2,3}$] (coalesced) in pre-consonantal position. In Majorcan, while MAX outranks UNIFORMITY, as elsewhere in Catalan, several constraints outrank MAX, and some cluster constraints (*3MAN]$_\sigma$, *2MAN]$_\sigma$C) are undominated.

5. Concluding observations

One aspect of the current conception of Optimality Theory is that the GEN component may supply candidates that are pronounced identically but that differ either in prosodic organization (syllable- and foot-structure, and so on[10]) or in correspondence relations. Here I have drawn attention to the latter type of alternatives differing in correspondence, and have attempted to demonstrate that a coherent account of phonological patterns cannot simply ignore the alternatives not favoured by the analyst. Is the theory too rich, in allowing such a plethora of candidates? Probably not, in that there are good reasons why both true deletion and coalescence have been identified as effective 'repairs' to violations of well-founded complexity constraints. Though I have not investigated the issue in this paper, the same logic requires that GEN freely offers 'breaking' candidates, that is, those with an INTEGRITY violation. Thus, in a language where breaking candidates can sometimes win —for example, when gemination of vowels or consonants is a means of satisfying the Stress-to-Weight principle— it is up to the analyst to demonstrate what constraints outrank INTEGRITY so as to prevent breaking candidates from winning across the board.

In my attempt to fix up Lamontagne and Rice's account of the D-effect in Navajo in the light of these observations, I observed that the version of the account where UNIFORMITY outranks MAX, allowing a true deletion candidate to win in some circumstances, also requires invoking constraints of the MAX(Feature) type. While MAX(Feature) constraints are not shown to be necessary in the account I offer here of cluster reduction in Ibiza Catalan, where MAX(Segment) ranks high and many coalescence candidates win, they are generally likely to

[10] In Wheeler (in press) I do attempt to show what constraint rankings exclude inappropriately syllabified candidates.

be appropriate in languages where Max(Segment) ranks lower. And in fact the account of cluster reduction in Majorcan Catalan in Wheeler (in press, chapter 7) where Max(Segment) ranks much lower than in the Ibiza variety, though still above Uniformity, does have recourse to Max(Feature) constraints. I believe the necessary approach to cluster reduction in general adds weight to the case not yet universally accepted for including in phonological theory constraints of the Max(Feature) type.

The description and analysis I have given of cluster reduction in Ibiza Catalan takes for granted the position universally adopted in the literature on Catalan that there is an affrication process involving coalescence, when a coronal obstruent stop is followed by a coronal strident fricative, so that, for example, /$\text{tot}_1\text{+z}_2$/ *tots* 'all.MPL' is realized [$\text{to}\widehat{\text{ts}}_{1,2}$] with coalescence, or, before a vowel-initial word [$\text{to}\widehat{\text{d}_1\text{.dz}}_{1,2}$] with coalescence and breaking (Wheeler in press §3.1). It may be that this interpretation should be re-examined, as it is not clear what objective observations it is founded on. Is there any empirical consequence of the choice between the representations [$\text{to}\widehat{\text{ts}}_{1,2}$] ('affrication with coalescence') and [tot_1s_2] ('no affrication or coalescence') (or indeed [$\text{to}\widehat{\text{t}_1\text{s}_2}$] —'affrication without coalescence'), or of the choice between [$\text{to}\widehat{\text{d}_1\text{.dz}}_{1,2}$] and [$\text{tod}_1\text{.z}_2$] (or [$\text{to}\widehat{\text{d}_1\text{.z}_2}$]) for the pre-vocalic realization? My suspicion is that there is not, once assimilation of place is assumed —Catalan coronal obstruent plosives are typically dental, while coronal sibilants are alveolar ([s]) or alveolo-palatal ([ʃ]), but clusters of coronals always share place. Perhaps it is right, then, in the analysis of languages like Catalan which display an affrication process, to no longer assume without argument that winning candidates are those with a representation such as [$\text{to}\widehat{\text{ts}}_{1,2}$], rather than [$\text{tot}_1\text{s}_2$] or [$\text{to}\widehat{\text{t}_1\text{s}_2}$].

Appendix

Table 1 consists of a taxonomy of segmental deviations from faithful one-to-one correspondence. The input strings given are assumed to comprise the whole domain, where this is relevant. Asterisks indicate which constraints are violated by the deviation in question; (*) denotes possible, even likely, penalization, contingent on the content of the corresponding strings.

	I-Contig	O-Contig	I-Adj	O-Adj	R-Anchor	L-Anchor	Linearity	Uniformity	Integrity	Ident(F)	Max	Dep
1. Aphaeresis (loss of an initial segment) abc → b′c′ e.g. #era → #ra						*					*	
2. Syncope (loss of an internal segment) abc→ a′c′ e.g. sit → st	*			*							*	
3. Apocope (loss of a final segment) abc→a′b′ e.g. are# →ar#					*						*	
4. Prosthesis (addition of a segment in initial position) abc → xa′b′c′ e.g. #re →#are						*						*
5. Epenthesis (addition of a segment internally) abc →a′xb′c′ e.g. est → esit		*	*									*
6. Paragoge (addition of a segment in final position) abc → a′b′c′x e.g. adr# → adre#					*							*
7. Metathesis (linear reordering of segments) abc → a′c′b′ e.g. ask → aks			*	*		(*)	*					
8. Metathesis on pivot (linear reordering retaining adjacency) abc → c′b′a′ e.g. aro → ora					(*)	(*)	*					
9. Breaking (= splitting) $a_1bc \to x_1y_1b'c'$ e.g. erk → eark				*					*	(*)		
10. Coalescence (= fusion) $a_1b_2c \to x_{1,2}c'$ e.g. sia → ʃa			*					*		(*)		

	I-Contig	O-Contig	I-Adj	O-Adj	R-Anchor	L-Anchor	Linearity	Uniformity	Integrity	Ident(F)	Max	Dep
11. Spreading (both breaking and coalescence of adjacent segments) $a_1b_2c_3 \rightarrow x_{1,2}y_{1,2}c'_3$ e.g. bidirectional mutual assimilation, uɒ → oɔ, or zj → ʒʒ			* (bc)	* (yc)			*	*	*	(*)		
12. Coalescence + breaking $a_1b_2c_3 \rightarrow x_{1,2}y_2c'_3$ e.g. zj → ʒj								*	*	(*)		
13. Epenthesis + breaking $a_1b_2c_3 \rightarrow a'_1b'_2xb'_2c'_3$ e.g. ara → ardra		*							*	(*)		*
14. Epenthesis + coalescence $a_1b_2c_3 \rightarrow x_{1,2}yc'_3$ e.g. ərt → rit		*	* (ab, bc)					*		(*)		*
15. Epenthesis + metathesis $a_1b_2c_3 \rightarrow b'_2xa'_1c'_3$ e.g. ərt → riət		*	* (ab)	* (ac)		(*)	*					*
16. Metathesis + breaking $a_1b_2c_3 \rightarrow a'_1b'_2a'_1c'_3$ e.g. ərt → ərət			* (bc)	* (ac)			*		*	(*)		
17. Metathesis + coalescence $a_1b_2c_3 \rightarrow b'_2x_{1,3}$ e.g. jrs → rʃ					(*)		*	*		(*)		
18. Syncope + breaking $a_1b_2c_3 \rightarrow a'_1x_3y_3$ e.g. kio → koo	*			* (ax)					*	(*)	*	
19. Syncope + coalescence $a_1b_2c_3 \rightarrow x_{1,3}$ e.g. tis → t͡s	*							*		(*)	*	
20. Syncope + epenthesis $a_1b_2c_3 \rightarrow a'_1xc'_3$ e.g. snt → sit	*	*									*	*
21. Syncope + metathesis $a_1b_2c_3 \rightarrow c'_3a'_1$ e.g. kio → ok	*			*	(*)	(*)	*				*	
22. Haplology $a_1b_2a_3b_4 \rightarrow a'_{1,3}b'_{2,4}$ e.g. lolo → lo							*	**				
23. Reduplication $a_1b_2 \rightarrow a'_1b'_2a'_1b'_2$ e.g. de → dede							*		**			
24. Gemination $a_1 \rightarrow a'_1a'_1$ e.g. o → oo									*			

	I-CONTIG	O-CONTIG	I-ADJ	O-ADJ	R-ANCHOR	L-ANCHOR	LINEARITY	UNIFORMITY	INTEGRITY	IDENT(F)	MAX	DEP
25. Degemination $a_1a_2 \rightarrow a'_{1,2}$ e.g. kk → k								*				

Table 1. Deviations from perfect segmental correspondence with the correspondence constraints that penalize them

References

Beckman, Jill N. (1998). *Positional Faithfulness.* University of Massachusetts, doctoral dissertation. ROA 234-1297.

Carpenter, Angela C. (2002). "Noncontiguous Metathesis and Adjacency". In: Carpenter, Angela C.; Coetzee, Andries W.; de Lacy, Paul (eds.). *Papers in Optimality Theory II. (University of Massachusetts Occasional Papers 26)*. Amherst, MA: University of Massachusetts Graduate Linguistic Student Association, pp. 1-25.

Côté, Marie-Hélène (2001). *Consonant Cluster Phonotactics: A Perceptual Approach.* MIT, doctoral dissertation 2000, revised. ROA 548-1002.

Dols Salas, Nicolau (2000). *Teoria fonològica i sil·labificació. El cas del català de Mallorca*. Universitat de les Illes Balears, doctoral dissertation.

Jiménez. Jesús (1999). *L'estructura sil·làbica del català*. València: Institut Interuniversitari de Filologia Valenciana/Barcelona: Publicacions de l'Abadia de Montserrat.

Kager, René (1999). *Optimality Theory*, Cambridge: Cambridge University Press.

Lamontagne, Greg; Rice, Keren (1995). "A correspondence account of coalescence". In: Beckman, Jill; Walsh Dickey, Laura; Urbanczyk, Susan (eds.). *Papers in Optimality Theory (University of Massachusetts Occasional Papers 18)*. Amherst, MA: University of Massachusetts Graduate Linguistic Student Association, pp. 211-223.

Lombardi, Linda (2001). "Why Place and Voice are Different: Constraint-Specific Alternations in Optimality Theory". In: Lombardi, Linda (ed.). *Segmental Phonology in Optimality Theory.* Cambridge: Cambridge University Press, pp. 13-45.

McCarthy, John J. (1995). "Extensions of Faithfulness [title page: Faithfulness in Prosodic Morphology & Phonology]: Rotuman Revisited". University of Massachusetts, Amherst, MA unpublished manuscript. ROA 110-0000.

McCarthy, John J. (2003). "OT Constraints are Categorical". *Phonology* 20: 75-138.

McCarthy, John J. (2005). "Optimal Paradigms". In: Downing, Laura J.; Hall, T.A.; Raffelsiefen, Renate (eds.). *Paradigms in Phonological Theory*. Oxford: Oxford University Press, pp. 170-210. [Previously available (2001) as University of Massachusetts, Amherst, MA, unpublished manuscript. ROA 485-1201]

McCarthy, John J.; Prince, Alan S. (1993). "Generalized Alignment". In: Booij, Geert; van Marle, Jaap (eds.). *Yearbook of Morphology 1993.* Dordrecht: Kluwer, pp. 79-153 [= ROA 7].

McCarthy, John, J.; Prince, Alan S. (1995). “Faithfulness and Reduplicative Identity”. In: Beckman, Jill; Walsh Dickey, Laura; Urbanczyk, Susan (eds.). *Papers in Optimality Theory (University of Massachusetts Occasional Papers 18)*. Amherst, MA: University of Massachusetts Graduate Linguistic Student Association, pp. 249-384 [= ROA-60-0000].

McCarthy, John J.; Prince, Alan S. (1999). “Faithfulness and Identity in Prosodic Morphology”. In: Kager, René; van der Hulst, Harry; Zonneveld, Wim (eds.). *The Prosody-Morphology Interface*. Cambridge: Cambridge University Press, pp. 218-309.

Pater, Joe (1999). “Austronesian Nasal Substitution and Other NC Effects”. In: Kager, René; van der Hulst, Harry; Zonneveld, Wim (eds.). *The Prosody-Morphology Interface*. Cambridge: Cambridge University Press, pp. 310-343.

Pons, Clàudia (2004). *Els contactes consonàntics en balear. Descripció i anàlisi*, Universitat de Barcelona, doctoral dissertation.

Wheeler, Max W. (in press). *The Phonology of Catalan*. Oxford: Oxford University Press.